AERONAUTICAL ENGINEERING REVIEW

INSTITUTE OF THE AERONAUTICAL SCIENCES

JUNE 1947

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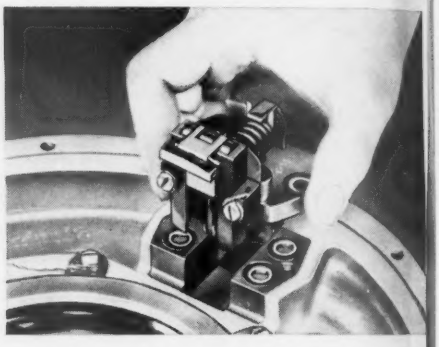
The advantages of the Aeroprop's self-contained, unit-constructed design are unique in the propeller field. Proved on many a military airplane, they justify themselves as fully in commercial use.

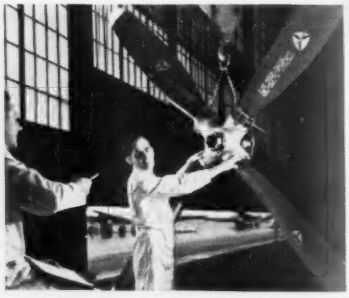
ONE-PACKAGE WEIGHT. No supplementary installations—motors, pumps, governors, etc.—to add weight and airplane design complexities. For instance, the governor (shown approximately 1/3 actual size) is part of self-contained regulator unit.



ONE-PACKAGE INSTALLATION. The Aeroprop is installed as a unit requiring no special engine or airplane fittings.

ONE-PACKAGE SERVICING. The Aeroprop can be inspected and serviced in record time—a single blade or the complete propeller can be replaced in a matter of minutes.

Many airplanes of the future will benefit from the Aeroprop unit-construction principle. Right now, Aeroproducts—backed by the vast facilities of General Motors—stands ready to cooperate with you in meeting your future propeller needs.



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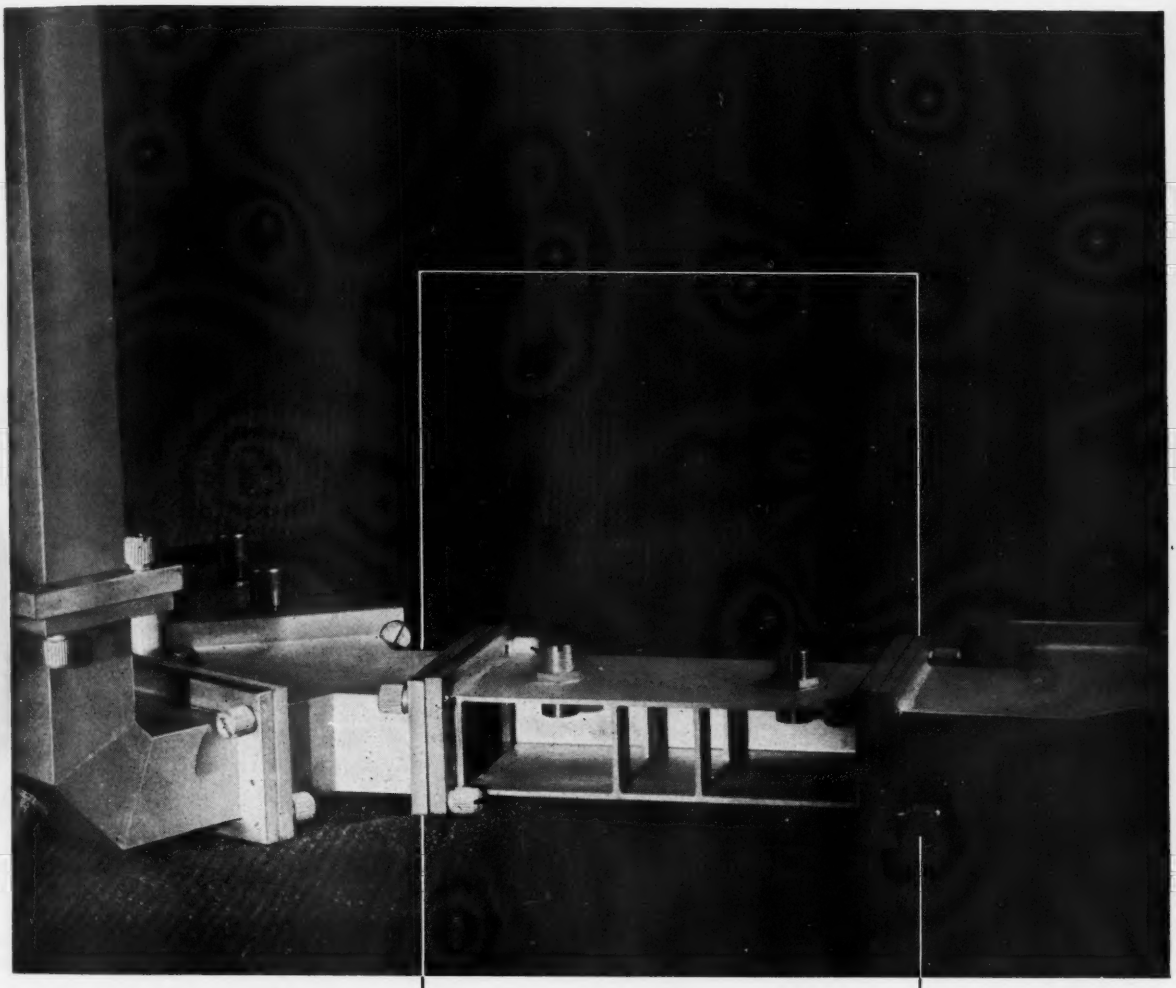
DESIGNING PROPELLERS TO MEET TOMORROW'S NEEDS

THIS IS THE AEROPROP—available in single or dual-rotation with instant-feathering, reverse pitch, electric de-icing, and all other features required for any installation. Regulator, hub and blade assemblies are designed for unit installation or replacement. It is strong, light and simple.

AEROPRODUCTS DIVISION • GENERAL MOTORS CORPORATION • DAYTON, OHIO



The two filters in the picture (one with side cut away) are used to separate two radio channels coming in on the same antenna but on different frequencies. At the end of the connecting waveguide, the channels are made to part company, each going to a different circuit through its assigned filter.

SEPARATION CENTER

FOR RADIO WAVES

Thirty years ago, when all telephone service went by wire, Bell scientists developed means of sending dozens of conversations over the same line.

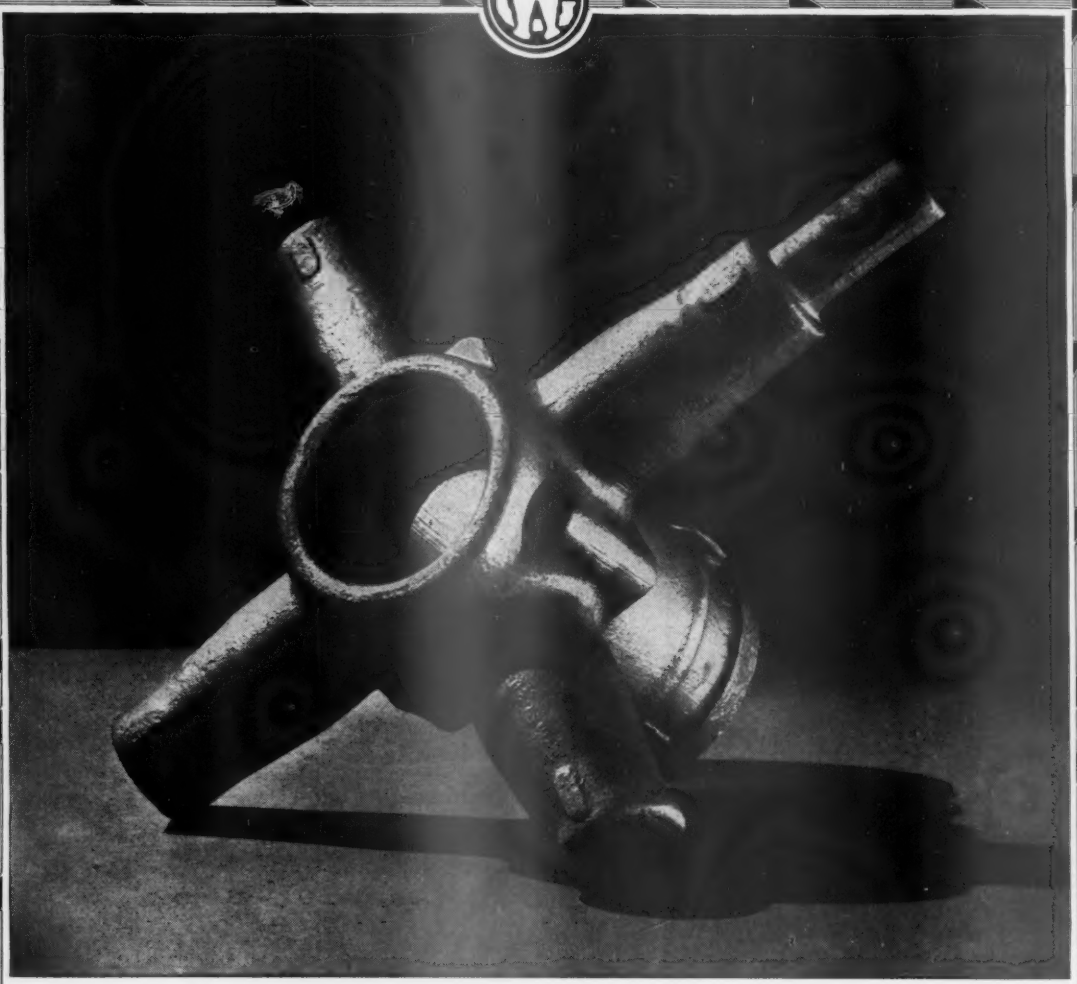
This they did by giving to each conversation a different *carrier frequency;* then to separate it from the others, they used a device which they had invented and named—the *electric wave filter.*

Today, in microwave telephone systems, the message-bearing waves pass to and from the antenna in pipes called waveguides. So scientists in Bell Laboratories devised a different kind of filter—a filter in a waveguide. This filter is a system of electrically resonant cavities formed by walls and partitions. Waves that set up sympathetic vibrations in the cavities pass through; others are reflected.

In the Bell System, now, single circuits are carrying many conversations at the same time through precision wave-filtering.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE



Many forging designs in steel, aluminum and magnesium have been originated by Wyman-Gordon. Typical of the many intricate forgings is this four-way spider.... Every Wyman-Gordon forging is under strict, constant control by laboratories that through the years have contributed much to investigation and research of new forging techniques and of new alloys of steel and the non-ferrous light metals.

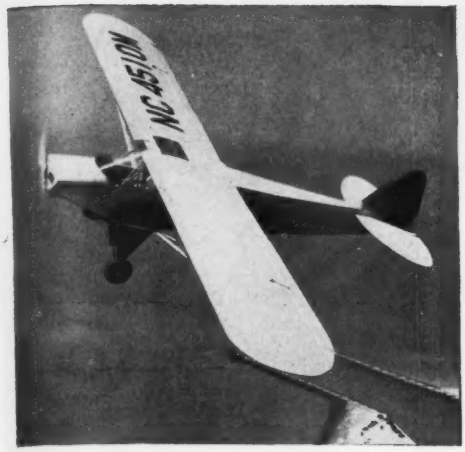
Standard of the Industry for Sixty Years

WYMAN-GORDON

Forgings of Aluminum, Magnesium, Steel

WORCESTER, MASSACHUSETTS, U. S. A.

HARVEY, ILLINOIS - - - DETROIT, MICHIGAN



Cover—The PA-11, new 1948 Piper Cub Special.

AERONAUTICAL ENGINEERING REVIEW

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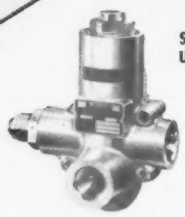
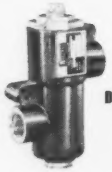
VICKERS HYDRAULIC EQUIPMENT on the CONVAIR-240



Vickers
Series AA-34500
Unloading Valve.



Vickers
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Balanced Piston Relief
Valve (2 Port).

Vickers
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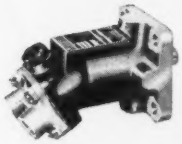
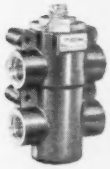


Vickers
Series MF-3906 Co
Displacement Pisto
Motor.

The 3000 psi main hydraulic system and the independent supercharger system for cabin pressurization and air conditioning of the Convair-240 include the Vickers aircraft units illustrated here. Vickers has a complete line of aircraft hydraulic equipment to exactly meet the needs of individual applications. For detailed information, please write us your requirements.



Vickers
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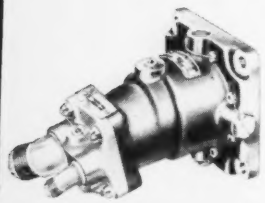
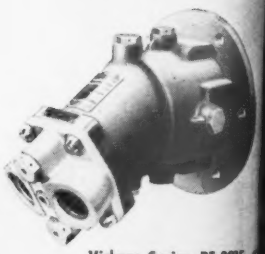
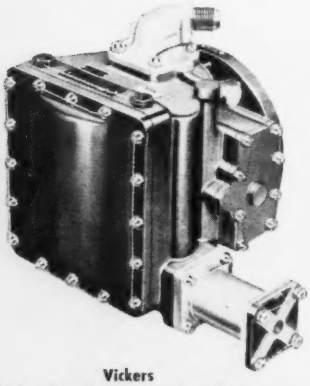
Balanced Pist
Relief Valve
(4 Port).



Vickers Series PF-3911 Constant
Displacement Piston Type Pump.



Vickers Series PF-3915
Displacement Piston Typ



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(Accurately controllable — infinitely
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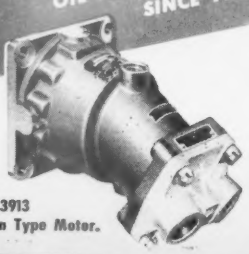
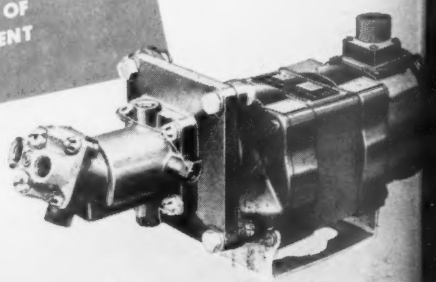


Vickers Series MF-3913
Constant Displacement Piston Type Motor.



Vickers Series AA-19020 Motorpump.

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Vickers
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Relief Valv
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I.A.S. News

A Record of People and Events of Interest to Institute Members

Annual Summer Meeting Scheduled in Los Angeles

Discussions and Papers Relating to Transonic and Supersonic Flight Constitute Major Portion of Program

AN EVENT OF prime interest and importance to the entire aviation industry will be the I.A.S. Annual Summer Meeting. For the third consecutive year the Los Angeles' Hotel Ambassador will be the location for a 2-day program consisting of four technical sessions, a luncheon, and the Annual Summer Meeting Dinner. The dates this year—August 7–8.

The Hon. James V. Forrestal will be guest speaker at the Annual Meeting Dinner, August 8, where Preston R. Bassett, President of Sperry Gyroscope Company, Inc., and present President of I.A.S., will act as Toastmaster. The dinner, to be held in the Main Ballroom of the Hotel Ambassador, will climax the two days of technical meetings. J. H. Kindelberger, President of North American Aviation, Inc., will be the speaker at the luncheon.

Current developments and the problems involved in transonic and supersonic flight are the main topics of papers and discussions scheduled for this meeting.

The chairmen and session topics are as follows: "Techniques of High-Speed Model Testing," Chairman A. R. Puckett, California Institute of Technology; "Progress in High-Speed Flight Research," Chairman Smith J. De France, Engineer-in-Charge, Ames Aeronautical Laboratory, N.A.C.A.; "Design and Performance Trends," A. E. Lombard, Engineering Consultant, Consolidated Vultee Aircraft Corporation; "Powerplant and Aircraft Development," Chairman A. E. Raymond, Vice-President—Engineering, Douglas Aircraft Company, Inc.

At the time this issue goes to press the following papers have been scheduled: "High-Speed Testing in the Caltech Cooperative Tunnel," by Clark B. Millikan, California Institute of Technology. "Full-Scale Free-Flight Ballistic Measurements," by L. A. Delsasso, Dirk Reuyl, and A. L. G. de Bey, Aberdeen Proving Grounds. "Instrumentation of Guided Missiles; Applications and Limitations," by Lester G. Zuckerman, Hughes Aircraft Company. "The Bell XS-1 Transonic Research Airplane," by Robert M. Stanley, Bell Aircraft Corporation. "Analysis for Optimum Transport Airplane Configuration," by P. A. Colman, Chief Aerodynamics Engineer, Lockheed Aircraft Corporation. "Trends in Aircraft and Engine Performance," by Milton U. Clauser, Douglas Aircraft Company, Inc. "Operational Aerodynamics of High-Speed Transport Aircraft," by R. S. Shevell, Douglas Aircraft Company, Inc. "Parameters Affecting Aircraft Weights," by W. F. Balhouse, California Institute of Technology.

The Program Committee, under the chairmanship of Willis M. Hawkins, Lockheed Aircraft Corporation, can safely promise a well-rounded and highly interesting meeting. Other members of the Committee are: Henry T. Nagamatsu, California Institute of Technology; Ralph Shick, Consolidated Vultee Aircraft Corporation; Joseph E. Barfoot, Douglas Aircraft Company, Inc.; W. H. P. Drummond, Douglas Aircraft Company, Inc.; Carlos Wood, Douglas Aircraft Company, Inc.; Eugene Blanford, Hughes Aircraft Company; Ed Redding, North American Aviation, Inc.; F. D. Enfield, Pan American Airways System; and Myron Tribus, University of California.

Willis M. Hawkins, Program Committee Chairman.

In view of the crowded conditions on the West Coast, all members and guests planning to attend the meeting are urged to make hotel reservations as early as possible.

I.A.S. Calendar

August 7–8, 1947	Annual Summer Meeting, Los Angeles, Calif.
September 2–6, 1947	Joint Meeting, Royal Aeronautical Society, London, England

For details see page 63.

Timoshenko Awarded 1947 James Watt International Medal

Dr. S. Timoshenko, teacher, author, and mechanical engineer, has been awarded the 1947 James Watt International Medal. An international authority on stress analysis and vibration problems, he has done much to spur teaching and research in the field of applied mechanics. As Professor Emeritus of Theoretical and Applied Mechanics at Stanford University, Dr. Timoshenko is continuing his lectures on Applied Mechanics.

The James Watt International Medal was founded by the Council of The Institution of Mechanical Engineers in 1936 to commemorate the bicentennial of the birth of James Watt. The award, bestowed every two years, is one of the highest international honors that a mechanical engineer can receive.

Dr. Timoshenko is a Fellow of the Institute.

S. Timoshenko.

Shoults Elected National Chairman of Aircraft Industries Association Committee

D. Roy Shoults, Vice-President in Charge of Engineering of the Bell Aircraft Corporation and an Associate Fellow of the Institute, has been elected National Chairman of the Aircraft Technical Committee of the Aircraft Industries Association. Mr. Shoults joined Bell Aircraft Corporation as Vice-President of Sales in 1945. He was formerly connected with General Electric Company's Aviation Division.

While with General Electric, Mr. Shoults was one of the principal figures in the development of jet propulsion engines in this country. He has been closely connected with jet development at Bell and in development of the XS series of planes. He has been Vice-President in Charge of Engineering since June, 1945.

D. Roy Shoults.

Zand Appointed Vice-President, Lord Manufacturing Company

Dr. Stephen J. Zand has accepted the appointment of Vice-President in Charge of Engineering of Lord Manufacturing Company, Erie, Pa. For the past 15 years Dr. Zand has been affiliated with the Sperry Gyroscope Company, Inc., as Senior Project Engineer and, more recently, as Director of Sperry's Vose Memorial Laboratory.

At the beginning of World War II, Dr. Zand, a veteran of World War I, took military leave from this position and was stationed in the European Theatre of Operations as Technical Expert in the Office of the Director of Technical Services, Air Service Command. Later he was appointed to the staff of the Scientific Advisor to the Commanding General in Washington.

Upon his return from overseas he became Technical Aide to the Vice-President of The Sperry Corporation. In this capacity he visited Argentina and Brazil.

Dr. Zand is a Fellow of the Institute and a Fellow of The Royal Aeronautical Society. An active member of the S.A.E. since 1928, he served as Vice-President of this organization in 1941. He was awarded the Wright Brothers Medal in 1931.

Stephen J. Zand.

Institute Members Reorganize Firm

T. N. Kelly, Member, and J. C. Squiers, Technical Member of the Institute, have been re-elected President and Secretary-Treasurer, respectively, in a reorganization move that changed the name of their engineering consulting firm from Kelly, Soellner and Squiers, Inc., to Kelly-Squiers, Inc. Mr. Kelly is Chairman of the Detroit Section of the Institute.

Gifts to the Institute Collections

Captain John Jay Ide presented over 300 issues of American and foreign aeronautical periodicals. Dr. Alexander Klemin added reports and papers to his previous generous gifts. Mrs. Bella C. Landauer added music to the collection she gave previously. The Cornell Aeronautical Laboratory, through the courtesy of Miss Elma T. Evans, gave ten translations of technical papers from the German. Henry F. Clark gave a set of sketches of military airplanes.

Additional gifts were received from the American Documentation Institute, British Intelligence Objectives Sub-Committee, Cornell University Engineering Experiment Station, Escher-Wyss Engineering Works, Great Britain Ministry of Supply, Samuel Herrick, Institute of International Education, Louisiana Aeronautics Division, New Zealand Air Department, Reading University, Smithsonian Institution, Transcontinental and Western Air, Inc., United Air Lines, U.S. Air Matériel Command, Civil Aeronautics Administration, Engineer Department, Forest Products Laboratory, National Roster of Scientific and Specialized Personnel, Office of Naval Research, and Congressional Committees on armed services, interstate and foreign commerce, and naval affairs.

News of Corporate Members

The Aeronca Aircraft Corporation, Middletown, Ohio, is now a Corporate Member of the Institute. In 1928 the first Aeronca was produced in the original factory at Lunken Airport, Cincinnati. During the ensuing 19 years the company has continued to improve and develop the private plane.

Prior to World War II, Aeronca built the Aeronca Collegiate, Scout, and Chief. The Aeronca low wing, introduced in 1936, was one of the first full-cantilever planes to be built in the low-priced field.

During the war, Aeronca was entirely engaged in war production and in subcontracting component parts of military aircraft. Aeronca Grasshopper liaison planes were built for the Army; the PT-19 trainers, for the Air Forces; and subassemblies, for B-17's and B'24's.

The newest plane in the Aeronca line is the Scout. This plane has side-by-side seating arrangement, dual wheel-type controls and heavy-duty oleo landing gear.

The company is now in the process of licensing a new all-metal plane to be called the Chum, a two-control plane. The Aeronca Corporation is continuing with research and development and looks to the future with confidence.

The Eaton Manufacturing Company has announced the formation of three new company divisions in Michigan which replace the former Wilcox-Rich Division.

The Valve Division with plants in Battle Creek and Lawton is manufacturing automotive, aircraft, and Diesel engine valves. The Pump Division at Marshall produces Eaton rotor pumps for various automotive, truck, tractor, and aircraft applications. The Saginaw Division produces hydraulic valve lifters, tappets, valve seat inserts, and Dynamatic fan drives.

Sales, engineering, and research departments for all three divisions will be located in Detroit.

United Air Lines, Inc., received their first helicopter in May. An engineer, a pilot, and a mechanic have been assigned to the Sikorsky plant at Bridgeport, Conn., for training and preliminary engineering studies of the Sikorsky S-51, the initial step in a long-range helicopter training program.

The helicopter will be flown to Chicago to conduct a comprehensive training program for other operational personnel. The craft, carrying a useful load of 1,250 lbs., will be used for extensive engineering analysis, including detailed studies under actual air-line operating conditions.

United officials said that such a program would enable the company to go ahead without delay if the Civil Aeronautics Board acts favorably on United's pending application for an air-mail helicopter route linking 32 communities in the Chicago area.

Sections and Branches

Buffalo Section

Buffalo Section members attended a dinner and technical meeting on April 24. The guest speaker, O. C. Koppen, Professor of Aeronautical Engineering, Massachusetts Institute of Technology, was introduced by George Otter, Chief Engineer of Fleet Aircraft, Ltd. Mr. Koppen's discussion of "The Stability and Control of Two-Control Airplanes" was presented spontaneously. No engineering formulas were given, only their effects.

Mr. Koppen stated that the two-control airplane can be made to operate as satisfactorily as the three-control plane, except possibly for the effort required to maintain a given heading in turbulent air.

The modifications required to produce a satisfactory two-control plane lead to increases of cost, weight, and drag. "Whether the advantages outweigh the disadvantages, only time will tell," Mr. Koppen concluded.

Dayton Section Is Reactivated

By E. W. Robischon, *Secretary*

After 5 years of inactivity, the Dayton Section held their reorganization meeting on May 1. The order of the evening was a dinner, business meeting, and a technical session. Approximately 100 members and guests from Columbus, Dayton, and suburban areas attended.

A. Francis Arcier presided at the Business and technical sessions because of the absence of Chairman Pro-Tem Brig. Gen. Donald L. Putt. Lt. Gen. N. F. Twining, Commanding General, Air Matériel Command, Wright Field, Ohio, opened the meeting with a short address. The following guests were then introduced: Major Gen. L. C. Craigie, Col. B. S. Kelsey, Col. H. M. McCoy, and Rear Adm. F. W. Pennoyer.

Robert R. Dexter, Secretary of the Institute, extended greetings on behalf of the I.A.S. headquarters.

Newly elected officers of the reactivated Dayton Section are (*left to right*): W. J. Blanchard, Col. A. A. Arnhym, E. W. Robischon, and C. L. Hall.

The following officers were elected unanimously: Chairman, Col. A. A. Arnhym; Vice-Chairman, W. J. Blanchard; Treasurer, C. L. Hall; and Secretary, E. W. Robischon.

At the conclusion of the business session Col. B. S. Kelsey, Chief Base Service Division, Assistant Deputy Commanding General, T-1, Wright Field, Ohio, presented a paper on "All-Weather Flying." Colonel Kelsey stressed several main points in his paper: the importance of accurate meteorological observation and forecasting; navigation equipment, from its earliest stages to its present development; and a description of an all-weather airport, including the problems involved in constructing it.

Philadelphia Section

On April 1 the regular meeting of the Philadelphia Section was preceded by a dinner. Both events took place at the Engineers Club of Philadelphia.

Edward Seckel, Research Associate, Department of Aeronautical Engineering, Princeton University, spoke on "The Geometry of Rotor Blade Hinge Arrangements."

The showing of four films concluded the meeting: *N.A.C.A. Helicopter Research, Humming Bird in Flight* (taken at 3,000 frames per sec.), *Gyroscopic Stability of a Fly*, and *Sperry Autosyn Compass*.

Seattle Section

Chairman G. S. Schairer opened the Seattle Section meeting on April 9 in the Chamber of Commerce Building. He discussed briefly the plans for future meetings prepared by the Program Committee.

Herbert A. Munter, Vice-President of Operations, West Coast Airlines, presented a paper on operations of his newly certificated regional air line. In his paper, Mr. Munter pointed out that their equipment and facilities are identical to that used by transcontinental air lines. However, operations, schedules, personnel, and overhead are different.

The common assumption that short-haul, local operations would serve only as a "feeder" setup for the big air lines is erroneous. Approximately only 11 per cent of West Coast traffic feeds into the bigger air lines. The majority of traffic is made up of business and pleasure trips between large cities and nearby small towns.

Seventy-five members attended the meeting.

Washington Section

Seventy members attended the meeting on April 16 at the U.S. Chamber of Commerce. Dr. Willy Ley, Research Engineer, Washington Institute of Technology, and former Vice-President of the German Rocket Society, traced the development of rockets from the year 1100, when the first solid-fuel rocket was invented, down to the present time. Dr. Ley placed particular emphasis on the development of rocket fuels. A discussion period followed the paper.

Academy of Aeronautics

Two meetings were held in March, one on the 7th and the other on the 21st. Marvin Glenn, Chairman of the Entertainment Committee, outlined a tentative social program for the new term. It was decided that the first social event would be a dance on April 12.

University of Alabama

The first meeting of the spring term was held on April 15. New officers announced at that time were: Chairman, Ross Robinson; Vice-Chairman, Norman Ponder; Secretary-Treasurer, Paul Greenlee; and Faculty Adviser, John W. Hoover.

Leith Potter, formerly connected with the Curtiss-Wright Propeller Division and at present a member of the University's Aeronautical Engineering Department, spoke on "Employment in the Aviation Field."

University of Cincinnati

On March 14, Maynard I. Weinstein, Senior Aeronautical Engineer, spoke on "Supersonic Aerodynamics."

A business meeting was held on March 21 to make plans for a party and also an inspection tour of Wright Field, Dayton, Ohio.

A joint meeting with the A.I.E.E. was held on March 26. Howard K. Morgan, Chief Development Engineer, Bendix Radio Corporation, spoke on "Air Navigation and Traffic Control."

University of Colorado

A combined I.A.S. and A.S.M.E. meeting was held on April 10 in the Engineering Administration Building. William H. Shutts, Instructor of Aeronautical Engineering, spoke on "Supersonic Wind Tunnels." Slides were shown of the proposed University of Colorado Supersonic Wind Tunnel.

University of Detroit

The I.A.S. Student Branch invited members of A.S.M.E., A.S.C.E., Tau Beta Pi, Pi Tau Sigma, and the Flying and Gliding Clubs to the meeting on March 12.

Robert S. Graf, Project Engineer, McDonnell Aircraft Corporation, described the Phantom. Mr. Graf's paper was followed by a McDonnell film, *The Phantom*.

Georgia School of Technology

On April 1, 18 members attended the showing of an Army film, *The Air Force Comes of Age*.

Helicopter Meet, filmed at the recent helicopter meet by D. W. Dutton, Head of the Aeronautical Department, Georgia School of Technology, was shown at a meeting on April 15.

Members of the Branch visited the Atlanta Traffic Control Center, the control tower, and the Weather Bureau at Chandler Field. Arrangements were made by E. I. Bricker, Aeronautical Engineering Department.

Harvard University

The Harvard Student Branch held a meeting on April 14 in Pierce Hall. Bernard Epstein, Research Fellow in Aerodynamics, spoke on "The Application of the Hodograph Method to Problems of Fluid Flow." Mr. Epstein discussed the use of the hodograph plane for the solution of fluid flow problems. The discussion was limited to two-dimensional, steady, irrotational flow of a nonviscous fluid.

University of Illinois

At a meeting March 26, Franz R. Steinbacher, Associate Professor of Aeronautical Engineering, discussed the nontechnical side of the engineering profession. Plans were made to hold a Branch picnic in May.

On April 9, William A. Benser, Head of the Fundamental Compressor Research Section, Compressor and Turbine Research Division, Aircraft Engine Research Laboratory, N.A.C.A., Cleveland, spoke on "The Purpose of the N.A.C.A." Mr. Benser described the duties of the N.A.C.A. and presented a short history of the organization. He accompanied his talk with slides showing the various types of engine tests being run at Cleveland.

Indiana Technical College

Edwin J. Davis presented statistics on airports and existing facilities for the private flier. Eugene F. Colditz's topic was "Methods of Production to Reduce Cost." Chester M. Jones reported on the new Beechcraft Bonanza, and Manual P. Costa discussed the possibilities of the helicopter.

University of Michigan

Dr. M. V. Morkovin, University of Michigan, presented a paper, "Problems and Purposes of the XS-1," at a meeting on March 12. Dr. Morkovin discussed the problems encountered in supersonic flight.

A business meeting was held, and committees were appointed to work on the Engineering Open House on April 14.

On March 25, 62 members attended a meeting in the Michigan Union. The speaker, Mr. Graf, McDonnell Aircraft Corporation, described the "Design, Construction, and Flight Testing of the Phantom."

Mississippi State College

A joint business and technical meeting was held on April 30. Two films were shown: *Working on Air* and *Autogiro*. It was agreed that meetings would continue through summer school.

New York University

C. E. Pappas, Chief Aerodynamicist, Republic Aviation Corporation, presented a paper, "Physical Aspects of Aerodynamics," at a meeting on April 14. A film showing the performance and flight characteristics of the XF-12 and the P-84 was presented.

Ohio State University

Carroll J. Pierce, Director of the School of Aviation, Ohio State University, spoke on "Aircraft Stability" at a meeting on April 1. He discussed stability, longitudinal and lateral, and the corresponding results obtained in wind-tunnel tests compared to full-scale models. Mr. Pierce illustrated his talk with slides of plotted data obtained from wind-tunnel observations.

On April 9, 40 members of the Branch toured the Aircraft Engine Research Laboratory, N.A.C.A., at Cleveland. Other members of the party were: Honorary Chairman, Edward L. Miller; Professor Von Eschen, Head of the Aeronautical Engineering Department; and C. J. Pierce, Director of the School of Aviation. It was generally felt that the tour provided an excellent insight into research methods used in solving aeronautical problems.

On April 29, Fred A. Hitchcock, Professor in the Department of Physiology, spoke on "Physiological Effects of High Altitude Flying." He presented a brief résumé of early balloon flights and the resultant physiological reactions. Slides were used to illustrate bodily reactions to high-altitude flight. The talk was concluded by the showing of two films that described experiments to determine the effects of explosive decompression on animals and on human beings. These tests are being made at Ohio State.

Parks College of Aeronautical Technology

On April 10 a meeting was held in the Aeronautical Engineering Building. A film, *Power by Wright and Wing Destruction Tests*, was shown. Chairman Charles F. Jahn announced that a trip to the McDonnell Aircraft Corporation would take place the last of April.

The Pennsylvania State College

Joseph Eisenhuth, Vice-Chairman of the Student Branch, spoke to the other members on "Carrier Take-Off and Landing Procedure," at a meeting on April 24. Chairman William W. Sunday followed up this talk with a description of carrier-deck equipment and mechanisms. The meeting was concluded by the showing of a film, *The Phantom*.

Stewart Technical

A joint lecture was presented by three students at a meeting on April 11. Goerge Desprez spoke on "Electrical Control"; Robert Morse, on "Aircraft Structures"; and Robert W. Wagner, on "Aircraft Instruments."

On April 25 Mario DiGiovanni, Dean of Engineering, read a paper prepared by Hugh De Haven, Director of Crash Injury Research, entitled "Greater Safety in Personal Aircraft." Slides accompanied the lecture.

Syracuse University

The first meeting of the Syracuse University Student Branch was held on April 1. The following officers were unanimously elected: Honorary Chairman, Leslie R. Parkinson; Chairman, Elton L. Bischoff; Vice-Chairman, Clarence E. Thompson, Jr.; Treasurer, Marvin B. Rothman; and Secretary, Patricia A. Shaver. By-laws were read and approved. Meetings were set for alternate Tuesdays.

The second meeting was held on April 15 in Lyman Hall. Each member was asked to volunteer for one of three committees: Meetings and Papers, Membership, and News and Research. William Etherington was appointed Chairman of a Constitution and By-laws Committee to revise the present by-laws.

Qualifications for membership were discussed. The majority favored allowing Freshmen to become members, as well as aeronautical students other than engineering students. This will include air transportation majors in the College of Business Administration.

Tri-State College

T. R. Wright, Jr., Tri State College Instructor, spoke on "Stability and Moments Determined by Wind Tunnel Tests," at a meeting on April 16. Possibilities for having a field trip to Wright Field have been investigated and plans are under way for the trip.

Tulsa University

A business and technical meeting was held on March 26. Plans were made to visit the Piper factory in Ponca City, Okla., in the near future. The meeting was concluded by a film, *The Record Winning PBY*.

Three films were shown at meetings April 11 and April 23: *Helicopter*, *Planes Without Pilots*, and *Jet Propulsion*.

Virginia Polytechnic Institute

Sixty-five members attended a meeting on April 7. Chairman D. Morton Bland opened the meeting and discussed the social calendar for the year. Following the business session, a film, *Planes Without Pilots*, was shown.

On April 21, 52 members met to hear A. E. Rowland, Instructor in the Aeronautical Department, speak on "The Aircraft Industry Today." Recently affiliated with the Beech Aircraft Corporation, Mr. Rowland presented a well-rounded picture of the light and medium-sized aircraft industries. Following a discussion by the entire group, the meeting was adjourned.

University of Washington

The first meeting of the spring quarter was held on April 9. The meeting was called for the purpose of presenting a survey of the employment situation in Southern California. Forty members attended.

Wayne University

A joint meeting of the I.A.S. Branch and the Detroit Glider Council was hel l March 28 at the Rackham Memorial Engineering Society of Detroit. Student Branch members from the University of Detroit and the University of Michigan were invited to attend. David Greenberg, Wayne University student, described the "Development of the Wayne University Glider." The features of the preliminary design of the glider were illustrated by a slide prepared by the Branch. Following the talk the meeting was opened for discussion. The members of the Detroit Glider Council contributed many ideas and suggestions.

News of Members

The primary purpose of these columns is to record the current activities of Institute members and provide information that is of interest and value to other members.

All members are invited (in fact, urged) to send in releases or letters promptly informing the editors of any changes in positions, promotions, achievements, or other news items.

James R. Benner has completed his service in the U.S. Naval Reserve and is now an Aerodynamics Engineer in the Chance Vought Aircraft Division of United Aircraft Corporation.

Arthur W. Beverage, Jr., has joined the Chance Vought Aircraft Division of United Aircraft Corporation as a Standards Engineer.

King D. Bird, previously employed by the Air Matériel Command at Wright Field, is now an Aeronautical Engineer in the Applied Physics Laboratory of The Johns Hopkins University.

Ralph F. Broberg has joined the Aeromechanics Division of David Taylor Model Basin as an Aeronautical Engineer. He had previously been a Flight Test Engineer at Republic Aviation Corporation.

Thomas A. Broun is now an Experimental Test Engineer in the Pratt & Whitney Aircraft Division of United Aircraft Corporation.

John S. Chikes is connected with United Air Lines, Inc., as a Pilot Instructor.

Frank A. Cleveland, formerly associated with the Aircraft Engine Research Laboratory of the N.A.C.A., has become an Aerodynamics Engineer at Lockheed Aircraft Corporation.

H. M. Conway, Jr., is now Manager of Southeastern Research Institute, Inc. He had been affiliated with the Ames Aeronautical Laboratory of the N.A.C.A.

Francis T. Courtney has joined the British Overseas Airways Corporation as a Technical Representative.

Alfred R. Crisi has become a Meteorologist (Forecaster) with the U.S. Weather Bureau in New York.

Ronal B. Crisman has completed his service with the U.S. Army Air Forces and is now a Structures Engineer at Cornell Aeronautical Laboratory.

Charles W. Deeds, who recently resigned as President of Niles-Bement-Pond Company, has been elected to the Board of Directors of Fairchild Engine and Airplane Corporation.

Robert T. De Vault has joined the Navy Research Project at the University of Southern California as a Technical Supervisor. He had been an Aerodynamicist at Northrop Aircraft, Inc.

Coleman du P. Donaldson is now an Aeronautical Research Scientist at the Langley Memorial Aeronautical Laboratory of the N.A.C.A.

John W. Elliott, formerly associated with Caterpillar Tractor Company, has become a Draftsman at Keystone Steel and Wire Company.

Charles R. Friday has joined Aviation Maintenance Corporation as an Electronics Technician.

Jack Frye, former President of Transcontinental and Western Air, Inc., has been named Chairman of the Board of General Aniline and Film Corporation and of General Dyestuff Corporation.

George M. Fuller, previously connected with Boeing Aircraft Company, is now an Instructor in Theoretical and Applied Mechanics at Iowa State College.

Richard P. Gillooly has joined McDonnell Aircraft Corporation as an Engineer.

Edward J. Goetsch, Jr., has become a Structural Test Engineer at Boeing Aircraft Company.

Alan H. Green, formerly affiliated with Edo Aircraft Corporation, is now an Aerodynamicist in the Special Projects Department of the M. W. Kellogg Company.

Robert N. Green has joined Republic Aviation Corporation in the capacity of Flight Test Engineer.

Robert E. Hage is now affiliated with Boeing Aircraft Company as a Preliminary Design Group Engineer.

Hubert N. Harmon, formerly of the Aircraft Engine Research Laboratory of the N.A.C.A., has joined Consolidated Vultee Aircraft Corporation as an Aeronautical Engineer.

Major Rudolph W. Hensel has been discharged from the U.S. Army Air Forces and is now Supervisory Aerodynamicist at the Cooperative Wind Tunnel at the California Institute of Technology.

Carlo O. Herrala has joined the U.S. Appraisal Company as a Mechanical Engineer.

Paul T. Homsher, formerly associated with Curtiss-Wright Corporation, has become a Flight Test Engineer at McDonnell Aircraft Corporation.

Thomas R. Huff has been separated from the U.S. Navy and is now Flight Training Specialist on the Aviation Training Staff of the Civil Aeronautics Administration.

Lester Israel joined the Columbus Plant of the Curtiss-Wright Corporation as an Aeronautical Engineer in the Research Department.

Milton Jakosky, former Chief of Airframe and Appliances Engineering Division, Civil Aeronautics Administration, New York Headquarters, has been promoted to the post of Chief of Aircraft and Components Division, with Headquarters at Honolulu.

Robert E. Kennedy is now Field Manager of Kaser Construction Company. He had been a Sales Engineer at Stavis Oil Company.

Emil Kissel has completed his Army Service and has joined Pan American Airways System as a Flight Engineer.

Dean G. Klampe is now connected with McDonnell Aircraft Corporation as an Aerodynamicist.

George Koch is now an Engineer in the Research Department at Whiting Corporation.

Frank G. Kreidler has joined the faculty of Duluth Junior College as an Instructor in the Engineering Department.

Charles P. Lach has become an Engineering Draftsman at The Glenn L. Martin Company.

Richard W. Lederer, formerly of Boeing Aircraft Company, is now a Design Layout Engineer at the Columbus Plant of the Curtiss-Wright Corporation.

Harlowe J. Longfelder is an Aerodynamics Engineer at Boeing Aircraft Company. He was formerly associated with Lockheed Aircraft Corporation.

James G. Loudermilk has completed his service with the U.S. Naval Reserve and is a Sales Engineer with The Texas Company.

Phil T. Mahaffey has joined Consolidated Vultee Aircraft Corporation as a Stress Analyst.

Edmund B. Maske, Jr., is now an Aerodynamicist at the Fort Worth Division of Consolidated Vultee Aircraft Corporation.

Robert McLarren, formerly Managing Editor of Air Age Publications, has been appointed Head of the Office of Research Analysis of the N.A.C.A.

Theodore W. Meyn has joined the Foreign Service of Pan American World Airways System.

Paul H. Peck is now a copywriter with Spencer W. Curtiss, Inc. He had been a Staff Member of the Radiation Laboratory at Massachusetts Institute of Technology.

Frederick C. Phillips has been appointed Professor of Aircraft Design at the Institute of Technical Aeronautics, a Branch of the Brazilian Air Ministry.

Albert V. Powell has joined The Glenn L. Martin Company as a Stress Analyst.

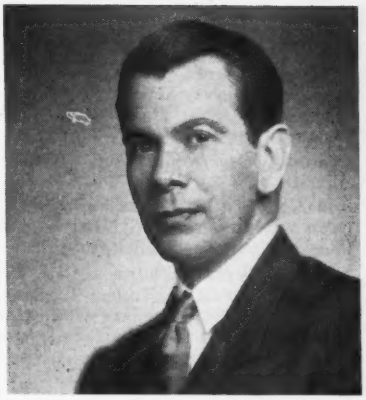
David F. Robertson, formerly affiliated with Globe Aircraft Corporation, is now an Engineer with Aviation Research Associates.

Herbert D. Rochen is connected with Chance Vought Aircraft Division of United Aircraft Corporation, engaged in power-plant analysis.

Jerome A. Ryan has become Assistant to the Chief Engineer at Klipfel Manufacturing Company.

H. T. Sagert.

Lee H. Smith.



Robert D. Spencer.

Harold T. Sagert is now General Manager of the Sagert Radin Company. He had been associated with Lear, Inc.

Robert H. Scanlan, formerly of Republic Aviation Corporation, has become Chief of the Dynamics Section, Airframe and Equipment Engineering Division, Civil Aeronautics Administration.

Gustaav H. Schirrmeister has joined the Engineering Division of American Airlines System as a Senior Designer in the Airports and Buildings Department.

Norbert C. Schnaubelt is now a Stress Analyst "B" at Consolidated Vultee Aircraft Corporation.

Evan H. Schuette, formerly of the Langley Memorial Aeronautical Laboratory of the N.A.C.A., has joined The Dow Chemical Company's Magnesium Laboratories as an Engineer in the Division of Tests.

John F. Scott is now connected with Consolidated Vultee Aircraft Corporation as a Service Engineer.

Irving A. Shepard has become President of Shepard Engineering Company. He is a former Chief Flight Test Engineer of McDonnell Aircraft Corporation.

Patrick A. Sherman is now an Engineering Draftsman at Consolidated Vultee Aircraft Corporation.

Lee H. Smith, formerly affiliated with Aeronca Aircraft Corporation, has been appointed Sales Manager of Beech Aircraft Corporation.

Robert D. Spencer has been appointed Acting Chief of the Pertinent Division, Airframe and Appliance Engineering Division, of the Civil Aeronautics Administration's Fort Worth Regional Office.

Franz R. Steinbacher, formerly of the faculty of the University of Michigan, has been appointed Associate Professor of Aeronautical Engineering at the University of Illinois.

Wieslaw Z. Stepniewski is now Chief of Aerodynamics at Piasecki Helicopter Corporation. He had been Chief Aerodynamicist and Structural Engineer at Jet Helicopter Corporation.

William E. Strohmeyer, formerly connected with Consolidated Vultee Aircraft Corporation, has become a Staff Engineer at Goodyear Aircraft Corporation.

Donald R. Suchner is now a Design Engineer at Goodyear Aircraft Corporation. He had been associated with Consolidated Vultee Aircraft Corporation.

George F. Taylor has joined Trans World Airline as a Flight Superintendent.

Albert S. Thompson is now a Research Engineer at North American Aviation, Inc.

Cyril C. Thompson, former Director of American Aviation Associates, Inc., has been appointed a Special Representative for Santa Fe System Lines.

Harley M. Thorson has become a Weight Engineer at Northwest Airlines, Inc.

Milton Toppel has joined American Airlines System as an Engineer.

Paul H. Treide is now an Electrical Designer at The Glenn L. Martin Company.

Harry A. Triche has become a Senior Detailer at McDonnell Aircraft Corporation.

James B. Vernon, formerly associated with Bendix Helicopter, Inc., is now a Vibration and Flight Test Engineer at Jensen Helicopter Company, Inc.

Willis D. Vinson, Jr., has joined North American Aviation, Inc., as an Aerodynamicist.

Alexandros M. Voutsas has completed his service in the U.S. Naval Reserve and is now an Aerodynamicist "B" at Consolidated Vultee Aircraft Corporation.

Walter C. Walling has become associated with the Ames Aeronautical Laboratory of the N.A.C.A. as an Aeronautical Engineer.

Robert E. Williams is now a Layout Draftsman in the Metal Products Division of The Ryan Aeronautical Company.

Frank M. Yamaguchi, formerly of Curtiss-Wright Corporation, has become Assistant Chief Engineer at Aero-Flight Aircraft Corporation.

Members Elected

The following applicants for membership or applicants for change of previous grades have been admitted since the publication of the list in the last issue of the REVIEW.

Elected to Associate Fellow Grade

Collar, Arthur Roderick, D.Sc.; Sir George White Professor of Aeronautical Engineering, University of Bristol (England).

Transferred to Associate Fellow Grade

Clauser, Francis H., Ph.D.; Chairman, Dept. of Aeronautics, The Johns Hopkins University.

Hokanson, Evert Carl, B.S. in M.E.; Manager, Aviation Div., Whiting Corp.

Elected to MEMBER Grade

Beler, Mehmet Selahattin, M.Sc.; Professor, Aeronautical Industry Institute, Turkish Aeronautical League (Turkey).

Bergman, Neil William, B.S. in Ae.E.; Group Engineer, Boeing Aircraft Co.

Bergrun, Norman Riley, B.S. in Ae.E. M.E.; Aero. Engineer, Ames Aero. Lab. N.A.C.A.

Catlett, William Jackson, Jr., B.S.; Comdr., U.S. Navy.

Cronvich, Lester L., Ph.D.; Mathematician, Applied Physics Lab., The Johns Hopkins University.

Dempsey, Arthur James, B.S. in M.E. Mechanical Engineer, Giffels & Vallet, Inc

Doley, John Oliver, M.A.; Chief Technician, Portsmouth Aviation, Ltd. (England).

Dowell, Millard Francis, M.S. in M.E.; Research Engineer, Aircraft Gas Turbine Div., General Electric Co.

Feeney, Thomas Aquinas, B.Ae.E.; Controls Section Supervisor, Northrop Aircraft, Inc.

Fiesenheiser, Elmer Irving, M.S. in C.E.; Assoc. Professor, Civil Engineering, Illinois Institute of Technology.

Frayling, Gerald William Kitto, West Coast Representative, Technical Liaison work for the British Supply Office (the official agency in the United States for British Ministry of Supply).

Harker, Kenneth Allen, B.S. in M.E. (Aero Option); Project Engineer, Design of Pilotless Aircraft Components, Naval Air Modification Unit, Navy Dept.

Kellner, Richard J., Asst. Chief Engineer, Cal-Aero Technical Institute.

Kendall, James Madison, B.S. in E.E.; Physicist, Section Head for Missile Aeronautics, Naval Ordnance Lab. (Washington, D.C.).

Maclure, Kenneth C., B.Sc.; Wing Comdr., Research & Development Div. in charge "Special Projects," Royal Canadian Air Force (Canada).

Malick, Emil A., Chief Aviation Technologist, Sales Technical Div., Phillips Petroleum Co.

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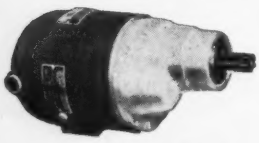

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Maloy, Harry Ellis, Jr., B.S. in M.E., Layout Engineer, Fairchild Aircraft Div.; Fairchild Engine & Airplane Corp.

Miller, Charles William, B.S. in Ae.E.; Aerodynamic Engineer "A," North American Aviation, Inc.

Miller, Donald B., B.S. in Ae.E.; Chief Engineer, Aircraft Propellers, Flottorp Mfg. Co.

Moskovics, Fredrick Ewan, Industrial Consultant, A. O. Smith Corp.

Nicholson, Hugh Gordon, Jr., Director of Training, Cal-Aero Technical Institute.

Robert, Guy Octave, Dipl. Ing.; Professor and Council Engineer, Ecole Nationale Superieure de L'Aeronautique (France).

Roberts, Norris Alden, Research Lab. Analyst "A," Lockheed Aircraft Corp.

Ross, Frederick W., Ph.D.; Asst. Director, Aero. Research Center, University of Michigan.

Rowe, Donald Cragier, M.E.; Executive Engineer, Bell Aircraft Corp.

Shutts, William Holland, B.S. in M.E. (Aero Option); Instructor in Aeronautical Engineering, University of Colorado.

Stedmon, Gerard M., Inspector 1/C Electronics, Aer. Lieanta, Teoranta, Collinstown Airport (Dublin, Eire).

SwamiRao, Belligund Ananth, Dipl. in Mech. & Electrical Engineering; Plant & Ground Engineer, Air-India Ltd. (Tata Air Lines), India.

van Lonkhuyzen, John H., A.M. in Math.; Asst. Project Engineer, Bell Aircraft Corp.

Warfel, John Spencer, B.S.; Manager of Research, Aerojet Engineering Corp.

Wight, Charles Linton, Jr., B.S. in C.E.; Major Layout Draftsman, The Glenn L. Martin Co.

Williams, David Tyndale, Ph.D. (Physics); Associate Professor and Research Physicist, University of Michigan.

Transferred to MEMBER Grade

Barzelay, Martin Elwood, M.S.; Design Engineer, Republic Aviation Corp.

Beck, Carl Augustus, Ae.E.; Flight Deck Design Engineer, United Air Lines.

Bell, Chauncey Frederick, Jr., M.S. in Engineering; Special Co-ordinator in charge of Eng. & Mfg. on C-54, The Glenn L. Martin Co.

Belzer, Maurice, B.Ae.E.; Engineering Designer, North American Aviation, Inc.

Benny, Richard Christopher, B.S. in Ae.E.; Major Engineer, High Altitude Test Flights, Boeing Aircraft Co.

Berwick, Lawrence Henry, Sub-Section Leader, Fuselage Design Group, A. V. Roe Canada Ltd.

Bisplinghoff, Raymond Lewis, M.Sc.; Asst. Professor, Aero. Engineering, Aero. Engineering Dept., Massachusetts Institute of Technology.

Black, Sydney Doree, D.Sc. in Applied Science; Chief of Airplane Dynamics Research Group, Columbus Plant, Curtiss-Wright Corp.

Bowe, David D., B.S. in Ae.E.; Sales Engineer, Aeroproducts Div., General Motors Corp.

Bresler, Boris, B.S. in C.E., M.S. in Ae.E.; Lecturer in Strength of Materials & Research Engineer, University of Calif.

Breuhaus, Waldemar Otto, B.S. in Ae.E.; Aerodynamics Engineer, Head, Engineering Section, Flight Research Dept., Cornell Aero. Lab.

Buchman, Walter Harold, Jr., Ae.E.; Asst. Professor of Co-ordination in Ae.E., University of Cincinnati.

Burdett, Harry Warren, Sr. Project Engineer, Reaction Motors, Inc.

Caprioglio, Elio, B.S. in M.E.; Group Leader, Landing Gear & Arresting Hooks, Grumman Aircraft Engineering Corp.

Caswell, Vincent Earl, B.S.; Stress Analyst, North American Aviation, Inc.

Charyk, Joseph Vincent, Ph.D.; Asst. Professor, Aero. Engineering, Princeton University.

Cole, Rossa William, M.Ae.E.; Asst. Project Engineer, Technical Data Div., Performance Section, Wright Aeronautical Corp.

Cone, Douglas Beebe, B.Ae.E.; Lead Engineer on Constellation Heat & Ventilating, Lockheed Aircraft Corp.

Daggett, Myron Lynd, Engineer, Major Layout & Design, Curtiss-Wright Corp.

Dickens, Irving Charles, B.S. in Ae.E.; Stress Analyst "A," North American Aviation, Inc.

Di Salvo, Francis Joseph, B.S. in Ae.E.; Supervisor of Engineering, Dorval Airport —in charge of design and service engineering groups, Trans Canada Airlines (Canada).

Diver, John R., B.S.; Project Engineer, Jet & Gas Turbine Engineering Development, Allison Div., General Motors Corp.

Fishbein, Meyer, M.E. in Ae.E.; Project Engineer, Northrop Aircraft, Inc.

Floyd, J. F. Rabardy, B.S.; Chief of Aerodynamics, The Glenn L. Martin Co.

Foster, Raymond Mayo, B.S. in Ae.E.; Aerodynamicist "A," Supersonic Wind Tunnel Tests, Consolidated Vultee Aircraft Corp.

Gibbs, Robert Ray, B.S. in Ae.E.; Stress Analyst "A," Hughes Aircraft Co.

Goldberg, Sydney Joseph, Asst. Supervisor, Missile Test Group, Aerophysics Lab., North American Aviation, Inc.

Goldin, Robert, M.S. in C.E.; Aero. Engineer P-5, Bureau of Aeronautics, Structures Branch, Navy Dept.

Goranson, Rolf Fabian, B.S. in Ae.E.; Asst. for Test Analysis, Pilotless Aircraft Aerodynamics, Bureau of Aeronautics, Navy Dept.

Gordon, Marvin Jerome, B.Ae.E.; Chief Aerodynamicist, Beech Aircraft Corp.

Harmon, Sidney Morris, B.Ae.E.; Aero. Engineer P-4, Asst. Head of Stability Analysis Section, Langley Mem. Aero. Lab., N.A.C.A.

Harris, Arthur St. George, A.F.R.Ae.S.; Engineer, Mechanical Controls Group, Canadair Limited (Canada).

Haselton, William Martin, B.S. in M.E.; Sr. Layout Designer, Acting Group Engineer, The Glenn L. Martin Co.

Hassett, Robert James, B.S. in M.E.; Instructor, special courses in Structural Design, The Glenn L. Martin Co.

Hellert, Melvin Gustave, B.S. in Ae.E.; Group Engineer, Controls, Supervisor on Design of Control Systems, The Glenn L. Martin Co.

Hitch, Robert Arthur, M.S. in M.E.; Project Engineer, Supersonic Wind Tunnel, De Laval Steam Turbine Co.

Hodder, Earle Stewart, B.S. in Ae.E.; Aerodynamics Engineer "A," Design & Flight Test Section, North American Aviation, Inc.

Hubbard, John Dean, B.S. in M.E.; Structural Design Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Immenschuh, William Taber, Project Engineer, Supervising, Design of Navy Fighter Aircraft, The Ryan Aeronautical Co.

Janes, Constantine John, B.S. in Ae.E.; Aero. Engineer P-4, Flight Analyst, Flight Engineering Div., C.A.A.

Johnson, Robert Pelley, B.S. in Ae.E.; Engineer "C," Aerodynamics Group, Beech Aircraft Corp.

Kauffman, Norman Nathan, Ae.E.; Design Engineer, Class "A," Consolidated Vultee Aircraft Corp.

Kepple, William Lloyd, B.Ae.E.; Aero. Engineer, Flight Research Branch, Aircraft Engine Research Lab., N.A.C.A.

Kessler, Edwin Laughton, B.S. in Ch.E.; Analytical Structural Engineer, The Budd Company.

King, Harold Smith, B.S.E. (Aero.); Helicopter Flight Test Engineer, Bell Aircraft Corp.

Krail, Arthur William, Jr., B.A.; Group Leader, Engineering Dept., Edo Aircraft Corp.

Kuhrt, Wesley A., M.S. in Ae.E.; Head, Gas Dynamics Section, Research Dept., United Aircraft Corp.

Lane, Winford Josiah, B.S. in M.E.; C.A.A. Designee on Power Plant and Miscellaneous Design, Lockheed Aircraft Corp.

Lentz, George Lawrence, B.S. in E.E.; Chief Sales Engineer, Power Plants, Menasco Mfg. Co.

Leppert, Elmer Louis, Jr., M.S. in M.E. (Aero Option); Aerodynamics Research Engineer, Flutter & Vibration Group, Lockheed Aircraft Corp.

Lessard, Roy W., B.Ae.E.; Chief of Structures, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Lester, William Albert, Engineering Designer "A," Consolidated Vultee Aircraft Corp.

Leuang, William Arthur, M.Ae.E.; Sr. Stress Analyst, The Glenn L. Martin Co.

Lew, James Nome, Staff Asst., Cost Control Dept., Beech Aircraft Corp.

Lewis, Robert Compton, B.S.; Research Engineer, Aero-Elastic Lab., Massachusetts Institute of Technology.

Lowell, Arthur Leon, M.S.; in Charge Pilotless Aircraft & Aerodynamics and Propulsion, McDonnell Aircraft Corp.

Maggin, Bernard, B.S. in Ae.E.; Supersonic Research, N.A.C.A. (Washington, D.C.).

McCollom, John Sylvester, B.Ae.E.; Civilian Employee, Flight Data Branch, A.M.C., Wright Field.

McCormick, Allen Henry, B.S. in M.E. (Aero Option); Engineer-Aerodynamics Unit, Aircraft Section, U.S. Army Air Forces (Civilian capacity), Wright Field.

McCullough, George Burns, M.E. in Ae.E.; Aero. Engineer, Ames Aero. Lab., N.A.C.A.

McFadden, William Clyde, B.S. in Ae.E.; Director of Planning, Pacific Airmotive Corp.

McKee, Dale William, B.S. in Ae.E.; Engineering Designer "A," The Ryan Aeronautical Co.

McNally, James Edwin, B.S. in Ae.E.; Airframes Engineer, Head of Aero. Section, Assembly & Repair Dept., U.S. Naval Air Station (Corpus Christi).

Mercer, Charles Rupert, Chief Flight Engineer, Flight Operations Dept., Lockheed Aircraft Corp.

Merkel, Stuart, B.Ae.E.; Power Plant Engineer, Republic Aviation Corp.

Miller, Webb, B.S. in M.E.; Aerodynamicist "B," Performance Section, Douglas Aircraft Co., Inc.

Millie, John H., B.S. in Ae.E.; Project Engineer, A. V. Roe Canada Ltd.

Morris, Charles William, B.S. in M.E. (Aero Option); Sales Engineer, Doak Aircraft Co.

Morris, John Kidd, B.S. in Ae.E.; Staff Engineer, Western Gear Works.

Mosehauer, Edward, B.S. in Ae.E.; Design Engineer, responsible for all blade design, Hamilton Standard Propellers Div., United Aircraft Corp.

Mueller, Robert Karl, Sc.D. in Ae.E.; Research Consultant, Fire Control Development Div. of Indust. Co-op.; also Asst. Professor, Aero. Engineering, Massachusetts Institute of Technology.

Oppenheim, Harold Everett, B.Ae.E.; Project Engineer, Development of Guided Missiles, Bureau of Aeronautics, Navy Dept.

Penhale, George E., B.S. in Ae.E.; Layout Draftsman "A," Empennage, Controls, Wings, McDonnell Aircraft Corp.

Perry, Felix Anthony, B.Ae.E.; Aircraft Project Engineer, Air-Frames Group, Northwest Airlines, Inc.

Peters, Elwyn Harvey, Production Design Engineer, Curtiss-Wright Corp.

Pope, Robert Alden, B.S. in Ae.E.; Research Engineer, Morgans Machine Co.

Powell, Walter Brown, M.S. in Ae.E.; Sr. Research Engineer, Jet Propulsion Lab., California Institute of Technology.

Purser, Paul Emil, B.S. in Ae.E.; Aero. Engineer, Pilotless Aircraft Research Div., Langley Mem. Aero. Lab., N.A.C.A.

Ranney, Daniel R., B.S. in Ae.E.; Structural Design Engineer, Piasecki Helicopter Corp.

Rao, Kuchi Srihari Muralidhar, B.Sc.; Sr. Inspector, Hindustan Aircraft Ltd. (India).

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(*Continued on page 57*)

I.A.S. Meeting Preprints

A limited number of copies of preprints of papers presented at meetings of the Institute are available for distribution, at a charge of 25 cents each to members of the Institute, and 75 cents to nonmembers, to cover handling and mailing charges. The following lists the preprints available from the past three national meetings of the Institute. Preprints may be ordered by number.

National Air Transport Meeting—Washington, D.C., October 24, 1946

27. Development of International Standards for Airworthiness of Transport Aircraft—Paul A. Puvrez, Expert, Airworthiness Division, Provisional International Civil Aviation Organization (PICAO). 9 pages; no illus. (Photo-offset.)

28. Air Conditioning of Transport Aircraft for Year Around Comfort in Flight and on the Ground—Bruce E. Del Mar, Mechanical Test Engineer, Santa Monica Engineering Division, Douglas Aircraft Company, Inc. 10 pages; 10 illus. (Photo-offset.)

29. Teleran for Air Navigation and Traffic Control—L. F. Jones, Manager, Research & Development Projects, Radio Corporation of America. 24 pages, bound in covers; 17 illus. (Printed.)

30. Survey of Air Rescue Requirements—Jerome Lederer, Chief Engineer, Aero Insurance Underwriters. 31 pages; 4 illus. (Photo-offset.)

Fifteenth Annual Meeting—New York, N.Y., January 28–30, 1947

31. Critical Speeds of Shafts Under Torque—R. M. Rosenberg, Instructor, School of Aeronautics, Purdue University. 34 pages; 8 illus. (Ditto.)

33. C.A.A. Testing of Helicopters—R. B. Lightfoot, Chief of Flight Research, Sikorsky Aircraft Division, United Aircraft Corporation. 23 pages; 6 illus. (Ditto.)

34. Progress in Dynamic Stability and Control Research—W. F. Milliken, Jr., Flight Research Department, Cornell Aeronautical Laboratory. 89 pages; 19 illus. (Ditto.)

36. A Method for Calculating Airfoil Sections from Specifications on the Pressure Distributions—Glenn L. Peebles, Design Analyst, Douglas Aircraft Company, Inc. 18 pages; 6 illus. (Ozalid.)

40. High-Speed Underwing Fueling—Eric Olsen, Manager, Aviation Division, The Wayne Pump Company. 8 pages; no illus. (Mimeographed.)

41. Transport Problems with Turbine Power Plants—Frank W. Kolk, Supervisor, Design and Performance, American Airlines, Inc. 10 pages; no illus. (Mimeographed.)

42. The Air Forces Development Program (Army Day Luncheon Speech)—Major Gen. Laurence C. Craigie, Chief, Engineering Division, Air Matérial Command, Wright Field. 16 pages; no illus. (Mimeographed.)

43. Problems of Naval Aviation Confronting the Aeronautical Engineer (Navy Day Luncheon Speech)—Rear Adm. L. C. Stevens, U.S.N., Assistant Chief, Bureau of Aeronautics, For Research and Development. 6 pages; no illus. (Mimeographed.)

Fourth Annual Personal Aircraft Meeting—Detroit, Mich., May 26–27, 1947

44. The Design Engineer's Role in Airplane Cost Reduction—Horrell Gustave Erickson, Structural Design Engineer, Luscombe Airplane Corporation. 11 pages; 3 illus. (Ozalid.)

45. Preliminary Design Studies: Piper Skysedan—W. J. Wilkie, Chief Design Research, Piper Aircraft Corporation. 22 pages; 4 illus. (Ozalid.)

46. The Flying Automobile, A Study of the Problem—J. M. Gwinn, Jr., Chief Engineer, Hoist & Body Section, Gar Wood Industries, Inc. 10 pages; 2 illus. (Mimeographed.)

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LESLIE E. NEVILLE, *Director of the Standard Aeronautical Index*

Mr. Neville, who recently joined the Institute staff to direct the S.A.I. project, has been a member of the editorial staff of *Aviation* magazine since 1928 when he was appointed Technical Editor. He became Managing Editor in 1930, and Editor-in-Chief in 1940. During the recent war he was assigned the concurrent task of development and editorial direction of *Wings* magazine, an Army-Navy sponsored publication which contributed substantially to the increased production of military aircraft engines and accessories.

He was coauthor, with Reginald M. Cleveland, of *The Coming Air Age;* Editor of the *Aviation Dictionary for Boys and Girls;* coauthor, with Nathaniel F. Silsbee, of a forthcoming book entitled *Jet Propulsion Progress;* and contributor to *Colliers Year Book, Funk & Wagnalls Year Book, Business Week, The Readers Digest,* and other publications. He has addressed a large number of service club meetings and radio audiences. During the 1946–1947 season he was a member of the speakers group for the Rotary Institutes of International Understanding.

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Editorial

Standard Aeronautical Index

For some months now, visitors at No. 2 East 64th Street have heard reference to a thing called "Project A." Nothing much could be said about it publicly, for, until very recently, it was nothing more than a gleam in the eyes of the Staff and some of the people around Wright Field and Washington. Now, however, the wraps can come off, and we can announce with considerable pride that "Project A" has become Contract *No. W 32-038 ac-17021* drawn up between the Army Air Forces and the Institute for the development of a Standard Aeronautical Index.

The need for a generally acceptable system for the cataloging and classifying (in the nonmilitary sense) of the vast flood of aeronautical information that is now flowing from hundreds of sources has long been apparent. Every librarian in industry and Government has done the best he could to devise a system whereby he could "ticket" all the items properly as they went by and file them away so that engineers and researchers could locate them easily and quickly. Naturally, no two individuals ever hit upon exactly the same scheme, and it was inevitable that as many different systems evolved as there were individuals to set them up. It is obvious, therefore, that each library must screen each piece of information that comes along and analyze it, according to its librarian's *individual* system, before filing it away. It is necessary, also, for anyone looking for that particular piece of information at some later date, to analyze his requirements in terms of the individual library system before he can find what he needs.

Add together all the individual effort that is expended for such purposes by librarians and researchers in aeronautical libraries every day and you soon arrive at a man-hour figure for unnecessary work that is astronomical. The aircraft industry is spending hundreds of thousands of dollars a year which may be saved once a single, standard system of handling such work is adopted. That is exactly the job that the I.A.S. is setting out to do, backed up by an Army Air Force contract that will provide the necessary funds.

Although the contract is to be administered by Wright Field, the Navy is in the project, too, with a generous contribution of funds. Cooperating, also, are the N.A.C.A., the Joint Research and Development Board, the Special Libraries Association, and a number of other agencies interested in the same problem. It is our plan to utilize the best of all the work that has been done on the problem to date to develop a system that can be accepted by all with a minimum of change from the way things are done at present.

The problem is not an easy one. A great deal of hard work lies ahead before we can say we have a final answer. We have in the Institute, however, a body of experience and a considerable amount of "know-how" on such problems, and the entire membership may take considerable pride in the fact that this organization was selected by the Army and the Navy as the one to undertake this important assignment.

S.P.J.

Morphology and Nomenclature of Jet Engines

F. ZWICKY*

Aerojet Engineering Corporation

Introduction

The considerations that will be presented herein involve a *new principle of scientific engineering* and an illustration of this principle in the field of propulsive power plants. The new principle concerns itself with the systematic classification of technical and scientific devices. Of primary concern in the field of jet propulsion are the power plants activated through chemical and nuclear reactions. But the following devices also fall within the range of this new type of classification—measuring instruments, telescopes, signaling apparatus, types of aircraft, and many others. The method of classification is as follows:

(1) A class of devices is defined through the purpose that these devices are supposed to satisfy. For instance, propulsive power plants are those that make possible the propulsion of certain craft such as cars, ships, planes, rockets through or over certain media such as the earth, bodies of water, and the atmosphere or through vacuum.

(2) After a class of devices has been defined, all possible members of this class are arranged in an orderly fashion in a so-called *morphological box* or manifold, the various dimensions of which represent possible ranges of values of significant physical and chemical parameters.

(3) The technical worth of any of the devices is ascertained through a general performance analysis.

The Morphological Box of Propulsive Power Plants That Are Activated Through Energy from Chemical Reactions

Propulsion may be accomplished either through the use of long-distance forces or of contact forces. The former may be forces of attraction or of repulsion. Propulsion by contact forces occurs when a jet either impinges on the vehicle under consideration or when a jet is emitted or exhausted from this vehicle. The latter type of jet will be designated as a *positive* jet, while the former will be called a *negative* jet.

The following considerations concern themselves solely with the propulsion that is the result of positive jets. Furthermore, we shall limit ourselves to chemical reactions as the sole source of energy. The use of other sources of energy such as nuclear reaction, radiation, etc., will not be discussed here.

The totality of propulsive power plants that are activated through positive jets deriving their energy from chemical reactions may be analyzed schematically as follows.

The Character of the Chemical Reactions

Four possibilities present themselves:

(1) The chemical reagents or propellants may be self-contained. This means that the device that is to be propelled carries with it all of the chemicals necessary for its activation and operation. The reagents may, for instance, consist of a fuel and of an oxidizer, such as alcohol and liquid oxygen, plus water as a coolant if such a coolant is needed.

(2) A device that is to be propelled through the air may take in this air and use all or part of its oxygen as the oxidizer. The device carries with it only the fuel.

(3) A device that is to be propelled through or over a body of water may take in this water and use it wholly or partly as one propellant reacting with a water-reactive chemical, such as liquid sodium-potassium alloy. The device carries with it this water-reactive chemical only.

(4) A device that is to be propelled through or over the earth may use this earth partly or wholly as one propellant reacting with an earth-reactive chemical. The moving vehicle carries with it only this earth-reactive chemical.

For purposes of formal representation, we designate the character of the possible chemical reactions through the matrix $(A_1, A_2, A_3, A_4) = A$ containing four elements as described.

The Mechanical Character of the Propulsive Device

There are four possible modes of motion of the principal activating parts of a propulsive power plant—namely, (1) no motion, (2) translatory motion, (3) rotatory motion, and (4) oscillatory motion. Strictly, we should consider the motion of the engine parts and of the propellants separately. For simplicity, we shall lump them together or perhaps more properly confine ourselves to the motion of the permanent mechanical parts of the engine relative to the working fluid. An axial compressor-turbine combination thus falls into category B_3.

The possible modes of mechanical motions are formally represented through the matrix $(B_1, B_2, B_3, B_4) = B$ containing four elements B_1, B_2, B_3, B_4 as described.

The Character of the Thrust Augmentation

The positive jets that cause the motion or acceleration of the propulsive power plants considered may be

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due entirely to a fluid flowing through the engine; or the jet may be reinforced through an alteration of the external flow of the medium surrounding the device. Such an alteration is, for instance, brought about through the action of an external propeller or of a wheel. In this case, we speak of *external thrust augmentation*. In the first case we speak of *internal thrust augmentation* provided that more external fluid is drawn through the engine than is necessary for the completion of the chemical reaction. In the third case, in which a stoichiometric ratio of propellants is made use of, we speak of *no thrust augmentation*. We therefore must consider the following three cases: (1) no thrust augmentation; (2) internal thrust augmentation; and (3) external thrust augmentation. The possible characters of the thrust augmentation are formally represented through the matrix $(C_1, C_2, C_3) = C$ containing three distinct elements as described.

The Physical State of the Propellants

Three different physical states of the propellants may be distinguished—namely, (1) the gaseous state, (2) the liquid state, and (3) the solid state. The physical states of the propellants are therefore formally represented through the matrix $(D_1, D_2, D_3) = D$ containing three characteristic elements.

The Mode of Operation of the Propulsive Power Plant

Two modes of operation are possible—namely, (1) continuous operation, and (2) intermittent (pulsating) operation, which may be periodic or more or less periodic.

The modes of operation are therefore formally represented through the matrix $(E_1, E_2) = E$ containing two elements E_1, E_2 as described.

The Reactivity or Reaction Speed of the Propellants

Two pure cases may be distinguished: (1) the propellants may be self-igniting; (2) the propellants are not self-igniting, and an artificial ignition is necessary which is accomplished through a special ignitor.

The reactivity characteristics of the propellants are therefore formally represented through the matrix $(F_1, F_2) = F$ containing two elements F_1, F_2 as described.

A *basic* propulsive power plant is schematically described through a matrix $(A_\alpha, B_\beta, C_\gamma, D_\delta, E_\epsilon, F_\zeta)$ containing one element each of the six elementary matrices A, B, C, D, E, F.

For instance, the aeroresonator with reed valves operating with a liquid fuel that, in air, is self-igniting can be schematically represented as $(A_2, B_2, C_2, D_2, E_2, F_1)$, while the hydroturbojet would be represented as $(A_3, B_3, C_2, D_2, E_1, F_1)$ if a liquid water-reactive chemical is used which with water is self-reacting.

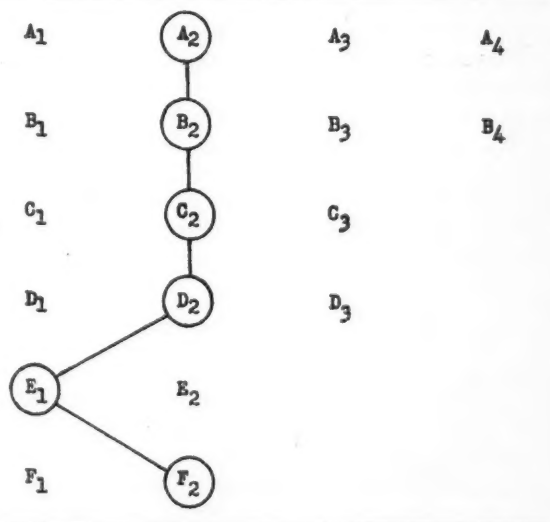
In reality, even the above scheme is capable of some refinements. For instance, in order to distinguish between the aeroresonator and the aeropulse, the additional distinction of a self-sustaining operation and a not self-sustaining but artificially timed and forced ignition must be considered. Neglecting for the moment refinements of this character, the combinations between the elements of the elementary matrices result in a potential totality of

$$4 \times 4 \times 3 \times 3 \times 2 \times 2 = 576$$

basic propulsive power plants activated through chemical reactions and the resulting positive jets. This totality of engines may be arranged in an orderly manner in a six-dimensional morphological filing cabinet with dimensions (edges) correspondingly representing the significant parameters A, B, etc.

It may, of course, happen that some of the drawers do not contain any reasonable device, if it happens that the specific set of parameters defining this drawer is self-contradictory. This might, for instance, be the case for engines that are characterized by matrices containing the elements B_4 (oscillatory motion) and E_1 (continuous operation). In general, therefore, a morphological filing "cabinet" of a given class of devices such as jet engines is complete if each drawer either contains one device or none. If a drawer contains more than one device, the analysis must be extended so as to introduce enough parameters to define each individual device uniquely.

Since a six-dimensional array is hard to depict, the following scheme may be used instead to define a specific device:



The propulsive power plant defined by the connected circles is the *aeroduct* activated by a liquid not self-igniting fuel (alias ram jet, Lorin tube, athodyd, or also aerothermodynamic duct). All other engines may be diagrammatically depicted or defined in a similar manner.

Some remarks must be made concerning refinements of the above scheme.

For instance, the numerical value of the propellant parameter β may decisively determine the character

of the propulsive power plant. This parameter is defined as

$$\beta = \frac{m_{ch}}{m_{ch} + m_f}$$

where m_{ch} is the mass of the chemical injected per second and m_f is the mass per second of the external medium involved in the operation. If β is large enough —for instance, in a hydroturbojet—the chemical propellant reacting with the water in the combustion chamber may partly consume this water and, in the process, evolve enough heat to transform the remaining water into superheated steam. For smaller values of β a part of the water may turn into wet steam, with the result that a gas containing droplets and perhaps solid particles flows through the turbine. For still smaller values of β water, as such, may flow through the turbine containing bubbles of gases that have been generated in the reaction.

Another case of refinement concerns the use of axial or of centrifugal compressors in turbojets, the use of oscillating reed valves or of coaxial and cross-axial valves in aeroresonators, and so on. Obviously, a great variety of types of engines results.

In addition to the basic propulsive power plants, combinatory power plants must be considered. The reciprocating engine-propeller combination falls into this vast category, since it involves oscillatory (B_4) and rotatory (B_3) motion simultaneously. Another combination is the double-ducted hydroturbojet, which is essentially a combination of an ordinary hydroturbojet and a hydroduct. It may be left to the reader to fathom the tremendous number of combinatory possibilities within the scheme described in the preceding.

It may be added here that in the future, when more will be known about rockets traveling in empty space, it might be convenient to introduce the freely available electromagnetic and corpuscular radiations as additional elements A_5 and A_6 into the fundamental matrix A.

The Problem of Nomenclature

In the initial stages of the development, only a few jet engines were known. Each inventor or group of inventors naturally assigned a more or less arbitrary designation to his creation. This practice, if continued, is apt to lead to considerable confusion because of the great number of possible propulsive power plants, the totality of which is so great that the problem of nomenclature assumes a character analogous to that of naming chemical molecules or chemical substances. Some agreement as to a systematic nomenclature clearly would seem to be in order. We therefore propose to make some simple suggestions with the view of submitting the issue to a national or international technically competent board for final decision.

The first suggestion is to use four prefixes depending on whether the medium through or over which the device is propelled is the vacuum, air, water, or the earth. The four prefixes chosen might be "*vacuo-*," "*aero-*," "*hydro-*," and "*terra-*." These prefixes also roughly determine suitable classes of propellants and of chemical reactions to be used for the activation and operation of the propulsive power plants in question.

Our second suggestion concerns the designation to be used for the various types of motion of the engine parts relative to the working fluid.

If there exists no initial relative motion between the propellants or of the working fluid, we speak of a *rocket* proper. If the motion is translatory, we propose the designation "*duct*." Such ducts are generally also present in propulsive power plants using rotors (rotatory parts) and pistons (oscillatory parts) for precompression of the working fluid. Since these rotatory and oscillatory motions are characteristic of the devices involved, we propose to use the words "*turbo-*" and "*piston*" to designate them.

The external thrust augmentation may be accomplished through the use of propellers, wheels, external trumpets, etc., while internal thrust augmentation need not be further characterized since it is determined through the numerical values of the propellant parameter β.

On the basis of the suggestions made we arrive at the following types of designations for propulsive power plants using free air and free water as part of the working fluid:

Plants with Free Air Intake	*Plants with Free Water Intake*
Aeroduct	Hydroduct
Aeroresonator	Hydroresonator
Aeropulse	Hydropulse
Aeroturbojet	Hydroturbojet
Aeroturbopropeller	Hydroturbopropeller
Aeropistonjet	Hydropistonjet
Aeropistonpropeller	Hydropistonpropeller

The aeroresonator and the aeropulse are distinct because one operates as a self-resonating engine while the other uses timed injection and ignition and reaction and is therefore more flexible.

Designations such as pulsejet, resojet, etc., for the aeroresonator are not unambiguous since there are many types of pulse jets and resojets. These designations are consequently unsatisfactory, and we propose that they be abandoned in favor of the more consistent scheme proposed in the preceding.

Another ambiguous designation currently in use for the aeroduct is the term "ram jet." There are actually many ram jets such as the aeroduct, the hydroduct, and others. These more specific terms should be used in preference to the name "ram jet."

The description of the remaining matrices D, E, and F, should cause no special difficulties. Thus we may speak of an aeroduct activated by a self-igniting liquid fuel. Abbreviations for these propellant characteristics might, however, be used such as L = liquid and I = self-igniting. (The Germans used the designation "Hypergol" in this case.) The above-mentioned aeroduct might thus be called an IL aeroduct.

The combinatory propulsive power plants also may be logically described by using the combinations of the words that define the basic power plants involved. Thus the double-ducted hydroturbojet might be called the hydroturbojet-hydroduct.

It is further suggested that standard diagrammatic representations of the various possible propulsive power plants be introduced for use in drawings. Thus the simple hydroturbojet and the combinatory double ducted hydroturbojet may be depicted as shown in Figs. 1 and 2.

Many of the devices that appear in our morphological analysis have not yet been constructed. This is particularly the case for most of the motors involving the earth as a working medium, except for those like ordinary cars and automobiles which use the earth as a most efficient external thrust augmentor.

It should again be emphasized that the principle of systematic classification presented in this paper is most useful because (1) the principle uncovers gaps in the array of existing power plants and (2) the principle gives suggestive directives for the invention and the construction of new engines. In this capacity the principle is most useful as a matter of intellectual and material economy.

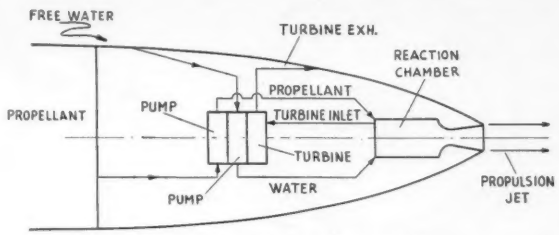


FIG. 1. Diagram of hydroturbojet.

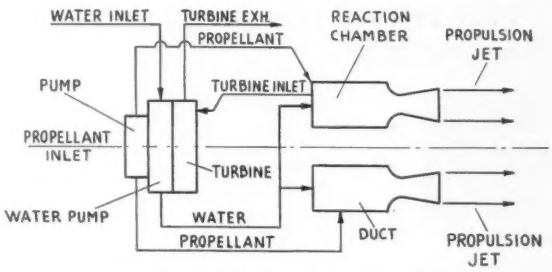


FIG. 2. Double ducted hydroturbojet.

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I.A.S. Briefs

Summaries of current papers received for publication or presentation at I. A. S. meetings

This Section gives advance and current information on papers presented to the Institute for publication or for presentation at meetings. Summaries of all pertinent papers, including those given at Section and Student Branch meetings, are published each month in these columns as rapidly as they are received from authors.

Many of these papers, after being processed by the Editorial Committee in the usual manner, will appear in full in later issues of the JOURNAL *or* REVIEW. *Others will be made available in preprint form. For information regarding available preprints,* *see page 15 of this issue.*

A Review of Service Experience with Aircraft Power-Plant Installations*

By
D. L. Posner
Civil Aeronautics Administration

This paper is based on C.A.A. records of aircraft accidents and reports of service difficulties that involve potential accident causes. These records cover the period from approximately 1932 to date. Although causes related to all parts of the airplane are included, this paper is primarily concerned with those associated with the power-plant installation. The paper points out the aspects of airplane power plants which require the most intensive effort from the standpoint of research, development, and design in order to raise safety standards.

The record indicates that the fuel systems of personal aircraft are by far the greatest offenders in causing power-plant failures. Predominant among the causes of failure is carburetor ice. Other contributing factors in the fuel system are accumulations of dirt and water, various system component failures, etc. Other aspects of the power-plant installation, such as exhaust, lubrication, cooling, and control systems, as well as instrument installations, accessories, etc., are discussed. The records of fire and the causes and cures are also covered.

* Presented at Fourth Annual Personal Aircraft Meeting, I.A.S., Detroit, May 26–27, 1947.

The Designer's Role in Airplane Cost Reduction*

By
H. G. Erickson
Luscombe Airplane Corporation

The future of the personal aircraft manufacturer is more than ever before dependent on the capability and ingenuity of its engineering staff. Greater competition and growing public resistance to high prices emphasize the need for more efficient design of the airplane, costwise. Since the cost of purchased parts is more or less the same for competitive manufacturers, it appears that the most promising approach to cost reduction would lie in simplifying the design of the airplane structure.

Herein are presented some approaches that have been made toward the design of various structural components of a personal airplane to permit fabrication with a minimum of labor, material, and indirect costs, including tooling, jigging, and miscellaneous overhead. It is contended that the optimum in design cannot be realized without thorough knowledge of cost breakdown of the various fabricating operations peculiar to the plant in which the structures are to be produced and, of course, complete current price listing of raw materials in all forms. Also, due consideration should be given to type of personnel that will be involved, equipment available, and the production load capacity of each individual piece of equipment. Considerable emphasis should also be put on the value of consultation with specialists of all departments concerned with the plant operations.

* Presented at Fourth Annual Personal Aircraft Meeting, I.A.S., Detroit, May 26–27, 1947.

Factors Affecting the Design of Quiet Propellers*

By
Arthur A. Regier and Harvey H. Hubbard
National Advisory Committee for Aeronautics

The factors affecting the design of a quiet propeller which are considered in this paper are divided into three categories, namely: acoustical, aerodynamic, and structural. The acoustical requirements for a quiet propeller indicate the

necessity for a substantial reduction in tip and rotational speeds and an increase in the number of blades. The aerodynamic requirements are that the propeller have a sufficient diameter and blade area to develop the required thrust efficiently. The structural requirements are that the propellers have a minimum of weight consistent with safety; namely, freedom from flutter, vibration, and excessive stresses.

The basic principles governing the design of a propeller which will fulfill the foregoing requirements are presented. Reference is made to various papers in which the relevant factors are discussed in detail. Charts giving the loudness and efficiency of representative propellers for light airplanes are given. The loudness charts show that the loudness of a propeller can be reduced to the vortex noise level but that further reduction will be difficult.

* Presented at Fourth Annual Personal Aircraft Meeting, I.A.S., Detroit, May 26–27, 1947.

Unified Design for Performance and Safety Characteristics*

By

Frederick W. Ross

University of Michigan

A quantitative method of rating airplane designs according to their flight and ground-handling characteristics is presented. A performance rating scale is given by a factor $\eta(\Delta W/W)(\Delta P/P)(\Delta V/V)$, where η is the propeller efficiency, ΔW is the pay load, W the gross weight, ΔP the maximum excess power, P the rated engine power, ΔV the speed range, and V the high speed. A safety rating scale is obtained from a weighted listing of the factors determining the safety, which includes certain performance items, control, stall, spin, and landing gear type. These two rating factors are used as ordinates for a performance-safety rating chart.

Analysis of the elements that determine the rating factors leads to certain criteria that indicate the effect of the various design parameters on the position of an airplane on the chart. This provides the designer with a method of selecting those features that give the better rating and, hence, higher performance and safety.

Use of the method has been made in the development of an improved airfoil and wing-flap-aileron configuration. No spoilers or slots are used. The Bendix Model 52, a two-place tractor airplane on which this wing design is used, has both exceptional stall and safety characteristics and exceptional performance. This is cited as an example of the improvements that can be made by the systematic unified approach to the flight and ground-handling problem as presented.

* Presented at Fourth Annual Personal Aircraft Meeting, I.A.S., Detroit, May 26–27, 1947.

The Flying Automobile, A Study of the Problem*

By

J. M. Gwinn, Jr.

Gar Wood Industries, Inc.

The Flying Automobile and the Roadable Airplane are differentiated and reasons are given for choosing the Flying Automobile as the more promising of the two. A brief study is presented of the economies of using standard automotive products. The surprising conclusion is reached that it is cheaper to use a minimum of them.

The fundamental problems of the Flying Automobile include weight distribution as it affects both center of gravity and moment of inertia; wheel suspension mechanics and spring rates; shock absorber damping rates; the question of one vs. two engines; and the control and transmission of power. With one engine further problems are valve timing, manifold distribution, and low efficiency at automobile cruising powers.

Other major problems are airplane drag reduction, without abnormal automobile body length or shape; propeller location from the standpoints of entrance hazard, comfort, airplane controllability, power transmission, and nonfreakish automobile appearance; and reduction in, and combining of, controls to avoid crowding the driver's seat area and to eliminate control problems in transition at take-off and landing.

These problems are discussed and possible solutions presented, to forewarn the designer and to assist him in avoiding general arrangements having fundamental defects.

* Presented at Fourth Annual Personal Aircraft Meeting, I.A.S., Detroit, May 26–27, 1947.

A Note on Flight Flutter Testing

By

Robert Rosenbaum and Robert H. Scanlan

Republic Aviation Corporation

Flight-testing for a condition of flutter in an aircraft is a difficult, and possibly dangerous, procedure. Flutter analysts have been excessively hampered in the progress of their work by a serious lack of practical confirmation of their calculated results. The typical flight flutter testing that has been done has been aimed at predicting the actual flutter speed of the aircraft in question. This is, of course, the primary engineering goal of the usual test but it has two shortcomings—first, the actual flutter speed may not safely be attained and second, even if approximated by extrapolation of test results this speed represents only a single test item to be checked against a single calculated item. A comparison then between flight-test flutter speed and calculated flutter speed is the only one possible, and the question of the validity of the theory behind the calculated results remains unanswered. If the flutter theory predicted what would happen at safe speeds of the aircraft, then experimental checks of this theory would be possible. Furthermore, a wide range of comparative check points could be obtained rather than confining attention to a single item. Thus, even if a given test result checked theory poorly it would be possible to check trends over a series of items. The aim of this note is to present a simple modification of standard flutter theory which aims at prediction of pre-flutter phenomena over a considerable range of airplane speeds. The theory is supported by test results that are in reasonably good agreement with it.

The Correlation of Wind-Tunnel and Flight-Test Stability and Control Data for an SB2C-1 Airplane

By

Marion T. Hockman and Robert E. Eisiminger, Jr.

Curtiss-Wright Corporation

Adequate correlation of comparable wind-tunnel and flight-test data has been neglected until recently. As a result, much of the accelerated design work that was carried on during the

war was done purely on the strength of wind-tunnel data alone with little reference to the possibilities of deviation from the wind-tunnel results by the actual flying product. In some cases, possibly, the differences were small and could be neglected but, in general, extensive programs of revision and modification showed up in the aircraft industry on the final flight product as a result of failure to correlate the available wind-tunnel and flight-test data on earlier models.

The correlation of comparable wind-tunnel and flight-test stability and control data for an SB2C-1 airplane shows the following results:

(1) The longitudinal stability determined from flight-test is generally greater than that determined from wind-tunnel tests.

(2) The longitudinal control characteristics show fair agreement as to trends, although there is nearly constant shift in the deflection vs. velocity curves.

(3) The stick forces are also in fair agreement but this is regarded as coincidental, since the effects of the high frictional forces found in the airplane control system were neglected in the analysis of the wind-tunnel data. In each case the forces were found to be of small magnitude throughout most of the flight range.

(4) The elevator effectiveness as determined from the flight-test data is slightly greater than that determined from the wind-tunnel tests.

(5) The accelerated flight data show close correlation.

(6) The correlation obtained for rudder control is not completely satisfactory because of the shift in the curves and the sometimes large difference in $d\delta_R/dV$.

(7) The agreement between the pedal forces is fair, but again this is considered coincidental because of the high frictional forces found in the airplane control system.

The source of the discrepancies between the two types of data cannot be precisely determined. However, it is believed that the contributing causes can be divided into two groups, each applicable to one type of data.

WIND-TUNNEL DATA: (1) Scale effects due to the low Reynolds Number of the tests. (2) Corrections to the data, such as tare and alignment corrections or the aerodynamic wall corrections. (3) Incorrect duplication of all power effects, such as propeller side forces, because of the use of a fixed-pitch propeller on the model. (4) Omission of some external drag items on the model, such as landing gear, lap joints, etc. (5) Use of solid wooden model having lower percentage structural deflections under load than the airplane.

FLIGHT-TEST DATA: (1) Incorrect estimation of the c.g. position, which must, of necessity, be based on an average c.g. position because of fuel consumption during any flight. (2) Presence of any longitudinal or vertical accelerations when the data are recorded. (3) Variation in flying technique of different pilots, or day-to-day variation in an individual pilot. (4) Deflection of airplane structures under air loads during flight, particularly wing or tail surfaces. (5) Variations in instrument accuracy and calibration due to atmospheric conditions, accelerations, or vibration.

It is not possible to state which of these items have the greatest effect since some will undoubtedly be of secondary importance. In view of the many possible sources of error, it is considered that the results of the correlation presented in this analysis are generally satisfactory and will further establish the use of wind-tunnel tests to predict the flight characteristics of airplanes.

Charts for Determining the Effect of Rotor-Tip Speed, Blade Solidity, and Rotor-Disc Loading on the Range of a Helicopter

By

J. P. Chawla

Cornell Aeronautical Laboratory

The problem of the range of a helicopter as affected by rotor-tip speed, blade solidity, and rotor-disc loading has been studied and the final results, based on certain simplifying assumptions, have been given in the form of charts from which the maximum range of a helicopter can be obtained for a given fuel to gross-weight ratio and for any combination of the above three design parameters. Since the thrust coefficient $C_T = (T/\rho)A\Omega^2R^2 \cong (W/\rho)A\Omega^2R^2$ combines the effect of both the rotor-tip speed, ΩR, and the rotor-disc loading, W/A, the final curves are given for maximum range/fuel to gross-weight ratio plotted versus C_T for various values of blade solidity, σ. Alternatively, maximum range/-fuel to gross-weight ratio is plotted against blade solidity for various values of C_T. Interpolation from these charts is easy and would not involve much error.

It is easy to incorporate into these charts the effect of changes in fuel to gross-weight ratio, overall efficiency of the engine rotor combination, and the specific fuel consumption of the engine. The factor that cannot be taken care of directly is the parasite drag of the helicopter. A value of $f/A = 0.01$, ratio of parasite-drag area to swept-disc area, has been used for these charts, which represents a good average value for the present-day helicopters having a single sustaining rotor, extended landing gear, and an antitorque tail rotor.

Notice

A Symposium on Applied Mathematics will be held at Brown University, Providence, R.I., August 2–4, 1947, under the sponsorship of the American Mathematical Society. The Institute of the Aeronautical Sciences will act as a cosponsor. The subject of the Symposium will be "Non-Linear Problems in the Mechanics of Continua."

All persons interested in receiving further information concerning the Symposium should write to **Prof. W. Prager, Brown University, Providence 12, R.I.** Copies of the program and reservation cards will be sent out to them 3 weeks before the date of the Symposium.

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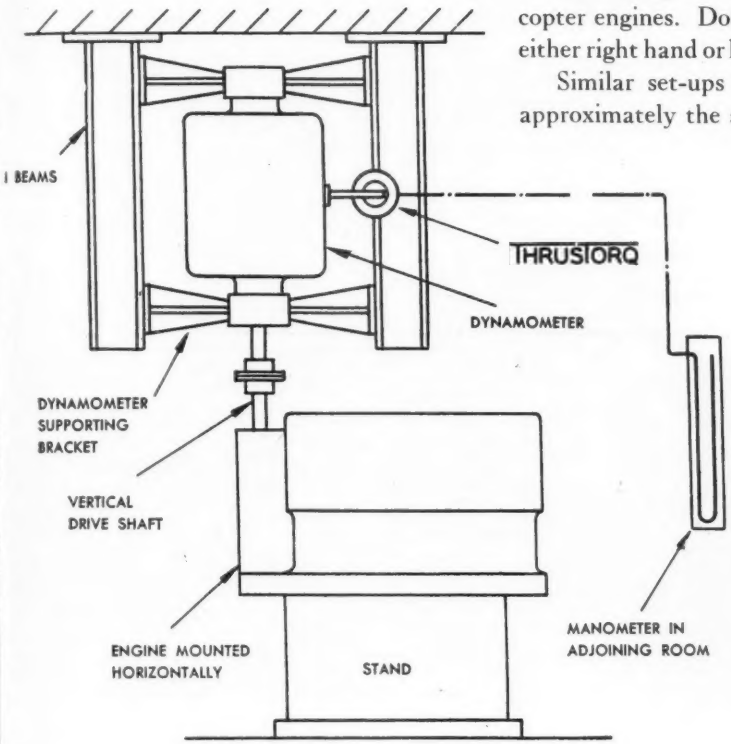

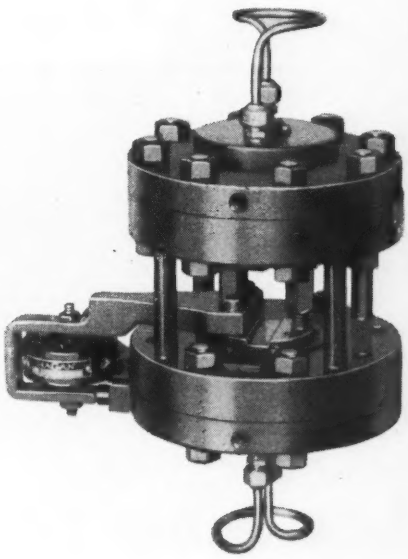

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FIRST IN RUBBER

Aeronautical Reviews

Aerodynamics

A Note on Flight Flutter Testing. Robert Rosenbaum and Robert H. Scanlan. *Republic Aviation Corp.* (For abstract see "I.A.S. Briefs" on page 25 of this issue, June, 1947.)

On Hypersonic Similitude. Wallace D. Hayes. *Quarterly of Applied Mathematics*, Vol. 5, No. 1, April, 1947, pp. 105, 106.

H. S. Tsien has presented a law of similitude for two-dimensional potential hypersonic flows over a slender body. It is shown that this similarity law is both much simpler in concept and much more general in scope than has previously been indicated, and is applicable to three-dimensional flow with shock waves and rotation.

A Second Note on Compressible Flow About Bodies of Revolution. W. R. Sears. *Quarterly of Applied Mathematics*, Vol. 5, No. 1, April, 1947, pp. 89–91, fig. 6 references.

The application of the linear-perturbation theory to the subsonic flow of a compressible fluid past a slender body of revolution was recently discussed by the author. It was shown that the several variants of the theory lead to inconsistent results when applied, for example, to the flow about ellipsoids of revolution, and it was stated that this ambiguity results from applying the theory to a case that is essentially nonlinear. It was implied that all the variants are equally valid so far as the first-order theory is concerned. It is shown here that the various procedures are not, in fact, equally acceptable, and that only one of them, in which the boundary condition is properly satisfied, can be considered to be correct, even to the first order.

The Lift Distribution of Swept-Back Wings. J. Weissinger. (*ZWB/FB/1553*, February 27, 1942.) *U.S., N.A.C.A., Technical Memorandum No. 1120*, March, 1947. 48 pp., figs. 16 references.

Two procedures for calculating the lift distribution along the span are given, in which better account is taken of the distribution of circulation over the area than in the Prandtl lifting-line theory. They are also applicable to wings with sweepback. Results of the methods, known respectively as the lifting-surface (F-method) and the lifting-line (L-method) agree excellently, although the former is numerically laborious for swept-back wings and therefore serves only as a check on the simpler L-method. Computations for the straight wing by the L-method require about 3 hours and for the swept-back wing about 8 hours. Results are compared with the Mülthopp method and with experimental results, and there is a brief note about the swept-back wing in sideslip.

Some Recent Contributions to the Study of Transition and Turbulent Boundary Layers. Hugh L. Dryden. *U.S., N.A.C.A., Technical Note No. 1168*, April, 1947. 44 pp., figs. 104 references.

The problem of the instability of laminar boundary layers may now be considered as essentially solved as the result of work completed since 1938. When the velocity fluctuations of the free-stream flow are less than 0.1 per cent of the mean speed, instability occurs as described by the Tollmien-Schlichting theory. Much theoretic work was done in Germany in extending the Tollmien-Schlichting theory to other boundary conditions, in particular to flow along a porous wall to which suction is applied for removing part of the boundary layer. The present state of knowledge of the mechanics of turbulent boundary layers and of the methods now being used for fundamental studies of the turbulent fluctuations in turbulent boundary layers is summarized. A brief review is given of the semi-empirical method of approach as developed by Buri, Gruschwitz, Fediaevsky, and Kalikhman. The aims and present status of the study, sponsored by the N. A. C. A., of turbulent fluctuations in a turbulent boundary layer under an adverse pressure gradient sufficient to produce separation, are described.

Laminar Boundary-Layer Oscillations and Transition on a Flat Plate. Galen B. Schubauer and Harold K. Skramstad. *U.S., National Bureau of Standards, Journal of Research*, Vol. 38, No. 2, February, 1947, pp. 251–292, figs. 24 references. (Cf. AER 3/47:41.)

These oscillations were found during an experiment in which transition from laminar to turbulent flow was being studied on the plate while the turbulence in the wind stream was being reduced to unusually low values by means of damping screens. Experimental methods that led to the discovery of the oscillations are described. The oscillations are shown to be the velocity variations accompanying a wave motion having all of the characteristics predicted by a stability theory based on the exponential growth of small disturbances. The work confirms a mathematical theory of stability which had been in the process of development for approximately 40 years, mainly by German investigators.

Laminar-Boundary-Layer Oscillations and Transition on a Flat Plate. G. B. Schubauer and H. K. Skramstad. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. W-8)*, April, 1943. 92 pp. figs. 24 references. (See preceding abstract.)

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Investigation of the Boundary Layer About a Symmetrical Airfoil in a Wind Tunnel of Low Turbulence. Albert E. von Doenhoff. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-507)*, August, 1940. 23 pp., figs. 12 references.

Investigation of Boundary Layer Transition on Concave Walls. H. W. Liepmann. *U.S., N.A.C.A., Advance Confidential Report No. 4J28 (Wartime Report No. W-87)*, February, 1945. 29 pp., figs. 8 references.

Air Flow in the Compressibility Region. K. W. Todd. *The Aeroplane*, Vol. 72, No. 1869, April 4, 1947, pp. 338, 339, illus.

Some simplified analogies are used to explain the meaning of the terms "Mach Number" and "compressibility." Shock wave and boundary layer phenomena also are discussed. How the research engineer can utilize the characteristics of a shock wave or compressible flow condition to bring about the visual observation of flow by optical means is described.

On a Conformal Mapping Technique. G. F. Carrier. *Quarterly of Applied Mathematics*, Vol. 5, No. 1, April, 1947, pp. 101–104, fig. 6 references.

The problem of finding the flow of an incompressible nonviscous fluid past a periodic array of airfoils may be replaced by that of determining the flow within a smooth closed streamline with a source-vortex and a sink-vortex at specified interior points. Analogous problems can obviously occur in other physical situations which lead to the Laplace equation. A method is developed for mapping a smooth closed curve conformally onto the unit circle so as to carry two arbitrarily specified interior points into the unspecified points.

Contributions to the Nonstationary Wing Theory. IX—Numerical Comparison of Various Approximation Theories on the Oscillating Wing of Large Aspect Ratio. Katterback. (*Göttingen, Aerodynamische Versuchsanstalt, ZWB/FB/1789*, April 14, 1943.) *U.S., Army Air Forces, Translation No. F-TS-943-RE*, February, 1947. 32 pp., figs. 11 references.

Lift coefficient calculations were made for an oscillating wing of elliptic plan form for the reduced frequencies $v = 1b/v = 0, 0.5, 1.0 \ldots 6.5$, using four known approximation methods. Results obtained from complex function theory were compared with strip analysis. The theory is outlined briefly and the equations used in calculations are derived.

Factorization of a Class of Determinants and Applications to Dynamical Chains. W. J. Duncan. *Philosophical Magazine*, Vol. 36, September, 1945, pp. 615–622. 4 references. (Reprint.)

It is shown that a class of determinants of order mn can be factorized as the product of n determinants of order m, each of which contains one of the latent roots of a matrix of order n. The theorem is applicable to the determinants of motion of a large class of dynamical chains, and in such cases the latent roots are real. Detailed applications are given to segmented aircraft wings and comments made on the case where the number of segments tends to infinity.

The Principal Directions of Loading and the Principal Directions of Forced Oscillation at a Point of an Elastic Body or System. W. J. Duncan. *Philosophical Magazine*, Vol. 36, October, 1945, pp. 715–719. (Reprint.)

A principal direction of static loading or of forced oscillation at a point is such that the displacement produced by a force acting in that direction at the point is parallel to the force. It is shown that for any point of a body or system which obeys Hooke's law and is conservative, there are three real mutually perpendicular principal directions which depend, in general, on the frequency of the applied force.

Vibration Surveys of the P-47-B Rudder and Fin-Rudder Assembly. Theodore Theodorsen and Arthur A. Regier. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. L-653)*, April, 1943. 19 pp., figs.

Flutter Tests on SB2U Model in 16-Foot Tunnel. Theodore Theodorsen, R. P. Coleman, and N. H. Smith. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. L-657)*, February, 1943. 52 pp., illus. 3 references.

Wake Measurements Behind a Wing Section of a Fighter Airplane in Fast Dives. De E. Beeler and George Gerard. *U.S., N.A.C.A., Technical Note No. 1190*, March, 1947. 18 pp., illus. 1 reference.

Results of measurements made in a vertical plane for a range up to Mach Number 0.78 showed that the critical Mach Number was exceeded by 0.05 before large increases occurred in the profile-drag coefficient; increases shown in wind-tunnel tests also occurred under flight conditions and they started at the same Mach Number value; increased drag coefficient was accompanied by an extension of the wake width, occurring first at the upper surface since the highest local velocity was obtained there. Wake measurements made in three-dimensional flow after shock has occurred cannot in general be interpreted in terms of section profile-drag coefficient because of pronounced lateral flow in the dead-air region behind the shock.

Some Effects of Reynolds and Mach Numbers on the Lift of an NACA 0012 Rectangular Wing in the NACA 19-Foot Pressure Tunnel. Thomas C. Muse. *U.S., N.A.C.A., Confidential Bulletin No. 3E29 (Wartime Report No. L-406)*, May, 1943. 10 pp., illus. 2 references.

Certain Reports of Aeronautical Research Prepared by Prof. Tomijiro Moriya, Tokyo Imperial University. Paul F. Helmick. *U.S., Army Air Forces, Intelligence Review No. F-IR-106-RE*, February, 1947. 48 pp., figs.

Translations of six reports: On the Aerodynamic Theory of an Arbitrary Wing Section; On the Thin Wing Theory; A Method to Obtain Airfoil Profile for a Given Pressure Distribution; On the Integration of the Biot-Savarts Law for Propellers; A Method of Calculating Aerodynamic Characteristics of an Arbitrary Wing Section; and A Formula for Calculating the Practical Strength of Propeller Blades.

Variation of Peak Pitching-Moment Coefficients for Six Airfoils as Affected by Compressibility. Harold E. Cleary. *U.S., N.A.C.A., Advance Confidential Report No. L4H17 (Wartime Report No. L-515)*, October, 1944. 27 pp., figs. 5 references.

Investigation of Extreme Leading-Edge Roughness on Thick Low-Drag Airfoils to Indicate Those Critical to Separation. Eastman N. Jacobs, Ira H. Abbott, and Milton Davidson. *U.S., N.A.C.A., Confidential Bulletin (Wartime Report No. L-659)*, June, 1942. 15 pp., figs. 1 reference.

Effects of Trailing-Edge Modifications on Pitching-Moment Characteristics of Airfoils. Paul E. Purser and Harold S. Johnson. *U.S., N.A.C.A., Confidential Bulletin No. L4I30 (Wartime Report No. L-664)*, September, 1944. 15 pp., figs. 9 references.

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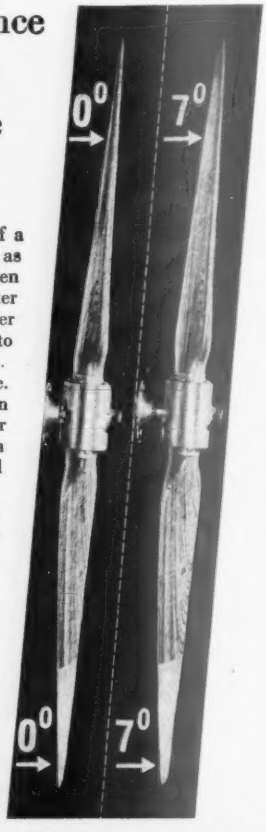


Beech Aircraft

CORPORATION WICHITA, KANSAS, U.S.A.

Theoretical Lift Force, Pitching and Hinge Moments of an Aerofoil with a Cambered Flap. J. Ripley. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2096*, October, 1944. 10 pp., figs. 5 references. British Information Services, New York. $0.60.

In order to study the effects of elevator skin distortion on longitudinal stability and trim, a preliminary idea of the extent to which elevator camber affects the forces and moments on the tail unit must be obtained. An analysis is made of the effect of flap camber on the lift and pitching moment of an otherwise uncambered airfoil and on the hinge moment of the flap itself. A theoretic solution is obtained for a thin airfoil in two-dimensional motion and the results are presented in a form applicable to any aspect ratio. These are compared with some experimental data on airfoils of 15 per cent thickness.

Systematic Wind-Tunnel Measurements on a Laminar Wing with Nose Flap. W. Krueger. (*ZWB/FB/1948*, June 13, 1944.) *U.S., N.A.C.A., Technical Memorandum No. 1119*, April, 1947. 17 pp., figs. 4 references.

Results are given of measurements of a Russian laminar profile 2315 Bis with nose flap, where the magnitude, form, and angle of attack of the flap had been systematically changed. The experiments were made at an effective Reynolds Number of 8.2×10^5. The most favorable lift increase attributable to the nose flap amounts to about 0.7, and the most favorable flap angle, measured with respect to the wing chord, is between 130° and 140°. A comparison with measurements on other profiles shows that the effect of a nose flap is essentially dependent upon the magnitude of the nose-radius coefficient of the profile.

Wind-Tunnel Investigation of Control-Surface Characteristics of Plain and Balanced Flaps with Several Trailing-Edge Angles on an NACA 0009 Tapered Semispan Wing. H. Page Hoggard, Jr., and Elizabeth G. McKinney. *U.S., N.A.C.A., Technical Note No. 1248*, April, 1947. 63 pp., figs. 12 references.

A comparison was made between lift and hinge-moment parameter values as calculated by existing methods from two-dimensional data and the parameter values measured from the test data were obtained. The differences between the measured values of the lift and hinge-moment parameters and the values calculated from two-dimensional data by lifting-surface theory were, in general, no greater than the differences between the measured values for wings of the same aspect ratio but with different chord distributions. The effects of overhang, gap, and trailing-edge angle on the lift and hinge-moment parameters were similar to the effects previously found in tests of two-dimensional models. Interference between bevel and overhang was indicated by the fact that the incremental effects of the overhang on the hinge-moment parameters varied as the trailing-edge angle was increased.

Force and Pressure-Distribution Measurements on a Rectangular Wing with a Slotted Droop Nose and with Either Plain and Split Flaps in Combination or a Slotted Flap. H. G. Lemme. (*ZWB/FB/1676-2*, May 14, 1943.) *U.S., N.A.C.A., Technical Memorandum No. 1108*, March, 1947. 23 pp., figs. 3 references.

The maximum lift increase, due to droop-nose deflection alone, amounted to 0.32. It is smaller than the value 0.55 obtained for a wing with simple droop nose. The maximum lift increases obtained by deflection of the slotted droop nose and simultaneous flap deflections are smaller than those that occurred with the corresponding model configurations with a simple droop nose. This is attributable to the fact that the absolute value of the low pressure points at the droop is greater for deflection of the slotted droop nose than for deflection of the simple droop nose. The separation of flow is favored. The slotted droop nose has no particular advantage over the simple droop nose.

High-Speed Wind-Tunnel Tests of Gun Openings in the Nose of the Fuselage of a 1/4-Scale Model. Henry A. Fedziuk. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-502)*, July, 1942. 12 pp., illus. 1 reference.

Air Transport—General

Development of Air Transport During the War. Ralph Cochrane. *Royal Aeronautical Society, Journal*, Vol. 51, No. 436, April, 1947, pp. 384–406, Discussion, pp. 406–416, illus.

During the 21 months ending in September, 1946, the Transport Command of the R.A.F. flew more passenger miles than did British civil aviation in the preceding 21 years, and in addition carried large quantities of freight. This volume of transport flying provided unique opportunities for testing new ideas and new equipment. An account is given of what was accomplished, and an examination is made of some of the lessons learned and the ideas for the future to which they gave rise. Figures and graphs show the rate at which the Command grew. Methods of training and measures taken to promote safety and reduce accidents are described, including the simplification of flying and navigation in bad weather and the reduction of pilot fatigue. The maintenance of traffic regularity is discussed, including the requirements for air frames, engines, and instruments.

World Aviation Statistics. Stuart A. Rice and C. Darwin Stolzenbach. *Air Affairs*, Vol. 1, No. 3, March, 1947, pp. 289–309.

Statistics are necessary in the formulation, administration, and judicial determination of public aviation policies and in the management of aviation enterprises. The statistics used are those relating to air transportation, government expenditures for subsidies and regulation, aircraft and equipment, air-navigation facilities, personnel, and accidents. The work of governmental and private agencies, both national and international, engaged in the compilation and dissemination of statistics is described.

Air Transport, Scheduled

Long-Distance Air Services. I. F. N. Hillier. *Modern Transport*, Vol. 57, No. 1462, April 5, 1947, p. 7. (Extended abstract of a paper.)

The conditions under which such routes as the North Atlantic and the Empire have been operated since the war, and the resultant operating costs are considered. An examination is made of operating costs of the aircraft which are at present being used on two of the three principal routes of B.O.A.C.—the Australian and the South African services. These are compared with costs calculated for an aircraft of a size and performance which might be regarded as giving satisfactory performance on these routes.

Anglo-American Civil Aviation. Peter G. Masefield. *Air Affairs*, Vol. 1, No. 3, March, 1947, pp. 310–322.

International conferences began in 1910 and subsequent agreements have dealt with the expanding problems of territorial sovereignty, competition, and regulation, leading to the Bermuda Conference of 1946 and the agreements reached there under which operations are now proceeding. International cooperation has resulted in the delivery of American-built transport aircraft to British and other European air lines for long-distance commercial services.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

Compañia Mercantil de Líneas Aéreas Españolas, S.A. (Iberia), Madrid. *U.S., Civil Aeronautics Board, Airline Manual Supplement*, March 11, 1947. 23 pp., map. 38 references. A report of the history, current operations, and territory served by the government-owned-and-operated Spanish air line.

The Case for 5-Man Specialist Crews. Harold G. Lambert. *Air-Sea Safety*, Vol. 2, No. 4, April, 1947, pp. 48–51, illus.

Airplane Descriptions

Martin Unveils New Jet Bomber. *Aviation News*, Vol. 7, No. 17, April 28, 1947, p. 11, illus.

Brief information about the XB-48 jet bomber, which has a wing span of 108 ft., an estimated gross weight of 105,000 lbs., and a useful load of 46,500 lbs.

United Air Lines Presents the New Mainliner 300, Douglas DC-6. *United Air Lines, Inc.*, 1947. 17 pp., illus.

Description of the interior layout, appointments, decoration, and passenger-comfort facilities, as well as a nontechnical outline of the mechanical features, control equipment, power plants, accessories, and other design details.

"Beaver" Bush Aircraft to Fly This Summer. *Canadian Aviation*, Vol. 20, No. 4, April, 1947, pp. 24, 25, illus.

A new Canadian de Havilland utility airplane for passengers and cargo, designed especially for Canadian open-country operation with either landing wheels, floats, or skis, is to be an all-metal, high-wing, semicantilever monoplane, powered by a 450-hp. Pratt & Whitney Wasp Junior engine.

The Beaver: Canada's Newest Bush Aircraft. Sandy A. F. MacDonald. *The Canadian De Havilland Gazette*, Vol. 2, No. 2, 1947, pp. 3–5, illus. (Cf. preceding abstract.)

High-Performance Plane Planned by Delanne. *Aviation*, Vol. 46, No. 4, April, 1947, p. 70, illus.

The construction in America of aircraft of "double monoplane" configuration with pusher propeller is planned by the Delanne Aircraft Corporation. A sharply tapered, low-aspect-ratio wing is mounted conventionally on the fuselage; at the rear, at the fuselage bottom, is placed a second wing, of smaller span, with sharply swept-back leading edges. The rear wing has twin vertical surfaces and rudders at the tips.

The Cloudster. Andrew R. Boone. *Air Trails and Science Frontiers*, Vol. 28, No. 7, May, 1947, pp. 42, 43, 112, 113, illus. (Cf. AER 2/47:35.)

Flying-Wing Development. John W. R. Taylor. *Flight*, Vol. 51, No. 1999, April 17, 1947, pp. 333–335, illus.

A review of the activities of Northrop Aircraft, Inc. Prototypes of various research, fighter, and bomber tailless aircraft, and a guided missile are briefly described.

Design Details of the Northrop XB-35. *Aviation*, Vol. 46, No. 4, April, 1947, pp. 37–41, illus.

Tail-Less Achievement. *The Aeroplane Spotter*, Vol. 8, No. 184, April 5, 1947, pp. 66–68, illus.

Review of the activities of the Horten brothers' organization in Germany and an account of the aircraft types designed and built by them.

German Aircraft in Detail. X—The Gotha Go 229 (Horten Ho IX). *The Aeroplane Spotter*, Vol. 8, No. 183, March 22, 1947, p. 52, illus.

Details about prototype versions of a high-speed German tailless fighter with swept-back wings, designed for use with jet propulsion engines.

New Shapes in the Air. VI—The Douglas D-558 Skystreak; The Leduc 0.10. *The Aeroplane Spotter*, Vol. 8, No. 184, April 5, 1947, p. 65, illus. (Cf. AER 3/47:45.)

Includes particulars about a French all-metal midwing monoplane with retractable nose-wheel-type landing gear, designed for research work at supersonic speeds.

Airspeed (AS.57) Ambassador. C. B. Bailey-Watson. *Flight*, Vol. 51, No. 1998, April 10, 1947, pp. 307–311, illus.

An analysis of the design features of the second prototype model, which will have a pressurized cabin. The wing form, wing joints, tail structure, and other design characteristics are appraised in detail.

The Auster V Series J/4. *The Aeroplane Spotter*, Vol. 8, No. 184, April 5, 1947, p. 69, illus.

A brief history of the development of the Auster V Series of private planes and specifications of two current models of this type.

Swedish Wings; An Account of the Wartime Activities of the Svenska Aeroplan Aktiebolaget. W. Green. *Flight*, Vol. 51, No. 1997, April 3, 1947, pp. 283–285, illus. (Cf. AER 2/47:36.)

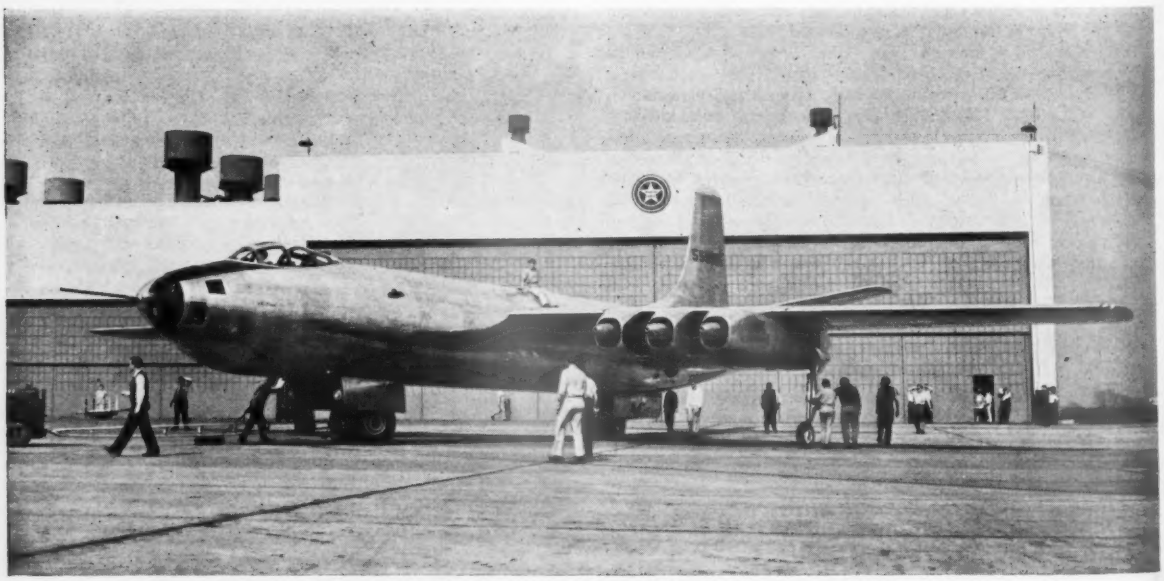
Design histories of the SAAB-17 dive bomber, -18 medium bomber, -19 fighter, -21 fighter, -23 fighter, -23 night fighter, -90 Scandia two-engine transport, and the -91 Safir personal airplane.

In Swiss Service. *The Aeroplane*, Vol. 72, No. 1866, March 14, 1947, p. 252, illus.

Illustrations and specifications of the C 3603 and D 3801 light fighter-bomber aircraft built at The Swiss Aircraft Factory, Lucerne.

New Shapes in the Air. V—The Aerocentre NC 3021 Belphegor; The Martin XP4M-1. *The Aeroplane Spotter*, Vol. 8, No. 183, March 22, 1947, p. 53, illus.

Particulars about a French prototype aircraft designed for meteorological, aerodynamic, and other research work, and an American long-range naval patrol-bomber.



The new Martin XB-48, built for the U.S. Army Air Forces, is now undergoing ground and taxi tests at Baltimore.

Unveiled: New and Improved Types of British Service Aircraft: Prototypes and Projects in All Classes. *Flight*, Vol. 51, No. 1999, April 17, 1947, pp. 338–342, illus.

Brief information about new types and variants, including the Airspeed Ayrshire 1 high-speed military transport; the Avro Shackelton G.R. 1 general-reconnaissance aircraft; the Blackburn S.28/43, designed for naval dive-bombing and torpedo-dropping; the Boulton Paul Type P.108 advanced trainer, for which the name Balliol T.1 has been chosen; a military adaptation of the Bristol 170; the Cierva E. 16/43 helicopter; developments of the de Havilland Vampire fighter; the Fairey N.F. IV night-fighter version of the Firefly IV; versions of the Gloster Meteor; the Handley Page Hastings C.1; a Heston communications aircraft; the Supermarine E.10/44 Attacker; and the Westland Wyvern F.T. 1 naval torpedo fighter.

American Civil Aircraft. *Western Flying*, Vol. 27, No. 4, April, 1947, pp. 16–42 (19 pp.), illus.

Brief descriptions, performance characteristics, illustrations and three-view drawings of 69 transports, personal airplanes, and helicopters produced by 47 manufacturers. Manufacturers' addresses and aircraft ATC numbers are given.

American Military Aircraft. *Western Flying*, Vol. 27, No. 4, April, 1947, pp. 44–72 (15 pp.), illus. Illustrated descriptions of 45 aircraft in current use or in the experimental stage.

Lightplanes of Today. *Canadian Aviation*, Vol. 20, No. 4, April, 1947, pp. 29 ff. (13 pp.), illus. Descriptions, illustrations, and performance characteristics of 32 American and Canadian airplanes, with a specification table.

Specifications and Performance Data on Certified Civil Aircraft in Use. *Western Flying*, Vol. 27, No. 4, April, 1947, pp. 74–78.

A table listing 183 aircraft in current use but no longer being produced. Specifications and performance data include wing and control surface areas.

Airplane Design

Unified Design for Performance and Safety Characteristics. Frederick W. Ross. *Paper presented at I.A.S. Fourth Annual Personal Aircraft Meeting*, Detroit, May 26–27, 1947. (For abstract see "I.A.S. Briefs" on page 25 of this issue, June, 1947.)

The Designer's Role in Airplane Cost Reduction. H. G. Erickson. *Paper presented at I.A.S. Fourth Annual Personal Aircraft Meeting*, Detroit, May 26–27, 1947. (For abstract see "I.A.S. Briefs" on page 24 of this issue, June, 1947.)

The Flying Automobile, A Study of the Problem. J. M. Gwinn, Jr. *Paper presented at I.A.S. Fourth Annual Personal Aircraft Meeting*, Detroit, May 26–27, 1947. (For abstract see "I.A.S. Briefs" on page 25 of this issue, June, 1947.)

An Approach to the Analytical Design of Aircraft. H. H. Cherry and A. B. Croshere, Jr. *Preprint, S.A.E. National Aeronautic Meeting (Spring)*, New York, April 9–11, 1947. 10 pp., figs. 6 references.

Starting with given specifications for stalling speed, cruising speed, take-off and landing distance, range, and direct operating cost, summary curves are developed for wing area, weight, climb, range, and other factors. These are combined into a summary plot that forms a polygon showing all of the design limits in their relationship to each other.

The Development of the Spitfire and Seafire. J. Smith. *Royal Aeronautical Society, Journal*, Vol. 51, No. 436, April, 1947, pp. 339–375, Discussion, pp. 376–383, illus.

The evolution of these wartime fighters is reviewed from the point of view of design. The early development of high-speed aircraft at the Supermarine works is first outlined briefly. An analysis is made of the relative importance of the different types to indicate developmental trends. Factors that maintained the efficiency of these aircraft at a high level for a period of 10 years also are analyzed.

The Development of Naval Aircraft. L. C. Stevens. *Preprint, S.A.E. National Aeronautic Meeting (Spring)*, New York, April 9–11, 1947. 9 pp.

German Aircraft Development as Applicable to Civil Transport. J. M. Gray, C. H. Jackson, and others. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 292, Item Nos. 5, 25, 26.* 16 pp., illus. British Information Services, New York. $0.55.

Evolution and Design of the XFD-1 Phantom. IV. Kendall Perkins. *McDonnell Airscoop*, Vol. 6, No. 21, April, 1947, p. 2, illus. (Cf. AER 5/47:35.)

Phantom Development: The Story of the Birth and Evolution of the First Jet Fighter for the U.S. Navy: The McDonnell XFD-1. John W. R. Taylor. *Flight*, Vol. 51, No. 1998, April 10, 1947, pp. 314–316, illus.

The Brabazon I. I—Structural Aspects of the Bristol 167. II—Structure of Tail Surfaces and Mainplane Described: Pressurization Problems Solved. *Flight*, Vol. 51, Nos. 1996, 1997, March 27, April 3, 1947; pp. 262–266; pp. 288–290; illus.

I. Details of the fuselage frame and skin construction. **II.** Details of the inner wing, rudder, elevators, the pressure joint between wing and fuselage, and the fuel tanks.

Supersonic Approach. H. F. King. *Flight*, Vol. 51, No. 1997, April 3, 1947, pp. 292a–292d, 293–295, illus.

Research problems connected with the investigation of flight at transonic and supersonic speeds, and methods of approach for their solution, are discussed. Experimental aircraft models and missiles being investigated in the United States, Great Britain, France, and Germany are described.

Why Pilots Make Mistakes. Wesley Price. *The Saturday Evening Post*, Vol. 219, No. 42, April 19, 1947, pp. 18, 19, 139, 141–143, illus. Examples are cited to indicate the need for improvements in aircraft design, particularly in cockpit controls.

Tests of Cargo Flooring-L for Aircraft. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1550-A*, October, 1946. 20 pp., illus.

Material designated as Flooring-L, consisting of round-corrugated aluminum alloy 0.040-in. thick, was tested and compared with previously tested Flooring-H which consists of flat-top corrugated aluminum alloy 0.051-in. thick. It was subjected to static bending, strip loading, impact loading, and rolling load tests. Stress-deflection and impact characteristics of Flooring-H are shown to be superior to those of Flooring-L; rolling load tests showed a slight superiority for Flooring-L after one thousand passages. The principal inferiority of Flooring-H was its greater weight.

An Investigation of Aircraft Heaters. XXV—Use of the Thermopile Radiometer. L. M. K. Boelter, R. Bromber, J. T. Gier, and E. R. Dempster. *U.S., N.A.C.A., Advanced Restricted Report No. 5A13 (Wartime Report No. W-88)*, April, 1945. 29 pp., illus. 5 references.

Fashions in Folds: Methods of "Trimming" British Naval Aircraft for Stowage Aboard Carriers. *Flight*, Vol. 51, No. 1996, March 27, 1947, pp. 266a, 266b, illus.

Airports

Fog-Clearing of Landing Strips on Airfields. Th. Benecke. (*Deutsche Versuchsanstalt für Luftfahrt, ZWB/FB/1025*, February 17, 1939.) *U.S., Army Air Forces, Translation No. F-TS-2645-RE*, April, 1947. 13 pp., illus. 17 references.

A Junkers Jumo 210 engine with a propeller capable of moving 11,000 cu.m. of air per min. was mounted in a test stand so as to cause the generated air stream to flow horizontally across the field, and a hot-air generator using a mixture of gasoline and air was mounted in front of the power plant. The blast of heated air cleared a tunnel-shaped passage through the fog, but upon shutting down the fan the fog closed in from the windward direction. The experiment was repeated several times, producing good visibility even when the wind direction was at right angles to the air stream. The tests demonstrated conclusively that fog-free air will move along the ground as a solid mass of clear air and will remain constant for considerable periods. The origin and characteristics of fog are also discussed.

Handling Civil Flying-Boats. E. C. Hodgson. *The Aeroplane*, Vol. 72, No. 1870, April 11, 1947, pp. 372–374, illus. (Extended abstract of a paper.)

The operation of flying boats by British Overseas Airways Corporation and factors that governed the selection of these aircraft for certain routes are reviewed. Consideration is given to the equipment requirements for marine airports and the necessary shore facilities, such as those required for maintenance. Other subjects discussed include future developments and terminal arrangements for efficient handling of traffic.

Douglas DC-4
Airplane Lubrication Chart DC-4
Art. 1276.5 (cont'd)
CONTROL PEDESTAL
PILOTS' CONTROL COLUMNS
PILOTS' SEATS
RUDDER PEDALS
FIRE EXTINGUISHERS
RUDDER TRIM TAB
PILOT'S WINDOWS LATCHES AND SLIDES
WINDSHIELD WIPERS
EMERGENCY DOOR HANDLE
FUSELAGE ACCESSORY COMPARTMENT
MAIN CABIN DOOR HINGES AND LATCHES
COMPARTMENT DOOR LATCHES
LOCKS ON LANDING GEARS
MAIN LANDING GEAR REAR DOORS
MAIN LANDING GEARS FRONT VIEW
MAIN LANDING GEAR WHEEL BEARINGS
NOSE WHEEL UPLATCH
NOSE WHEEL FRONT VIEW
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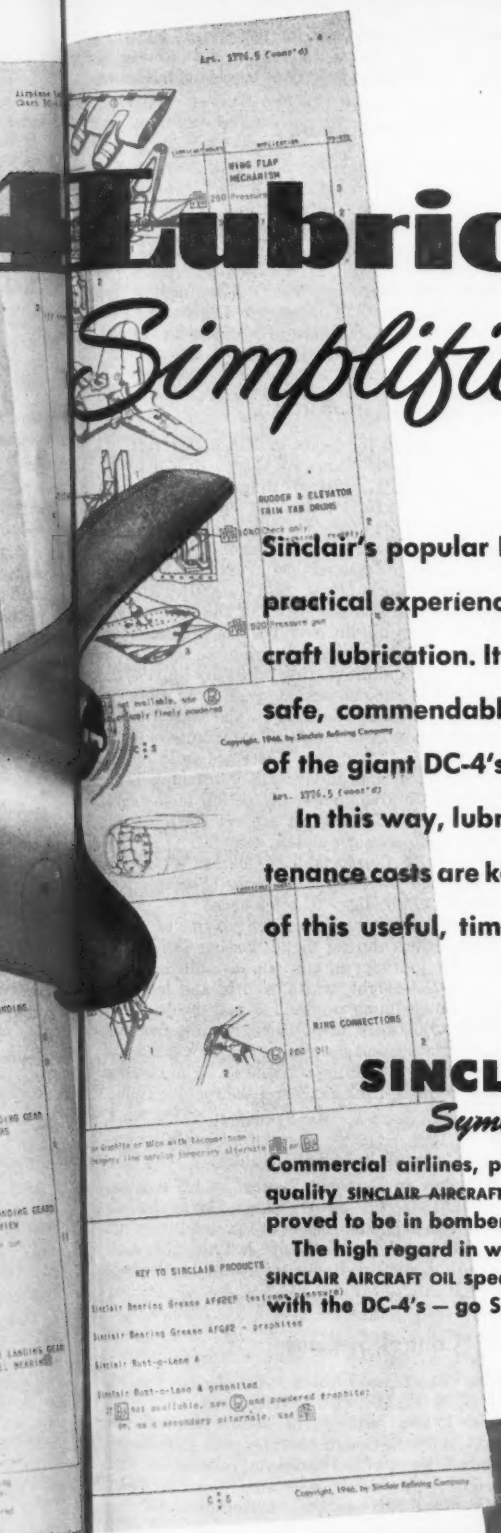
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RUDDER & ELEVATOR TRIM TAB DRUMS
RING CONNECTIONS
KEY TO SINCLAIR PRODUCTS
Sinclair Bearing Grease AFGDP
Sinclair Bearing Grease AFG2 - graphited
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Sinclair Rust-o-Lene A graphited
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Lighting of Seadromes. II. A. L. Lewis. *Aero Digest*, Vol. 54, No. 4, April, 1947, pp. 66, 67, 142, illus.

Wartime developments in seadrome lighting are reviewed. Particulars are given about the Navy BuAer Type FMF-6 light which proved satisfactory under adverse conditions in the Southwest Pacific. Information is supplied about the performance of pram-mounted lights, pile-mounted lighting systems, and radio-controlled, and buoy-mounted lights.

Lights Are Needed Too. W. H. Edman, *Airports*, Vol. 11, No. 4, April, 1947, pp. 16, 17, figs.

The requirements for proper runway lighting for all weather landings are discussed and particulars are given about Bartow high-intensity ground lights.

All-Weather Airport Approach Lighting System Announced. *Westinghouse Electric Corp., Release*, Recd. May 7, 1947. 11 pp., illus.

The system comprises three parts: approach lights, consisting of 36 krypton flash units each with a brilliancy of 3,300,000,000 peak beam candle power, placed in line alternately with 36 neon blaze units for a distance of almost three-quarters of a mile from the approach portal to the start of the runway; a runway designator, an 83-ft. combination red cross or green arrow; and runway lights of 100,000 candle power intensity spaced at 200-ft. intervals along the runway border. Two approach-angle indicators are installed near the head of the runway.

Landing Aids for Safety. John H. Frederick. *Southern Flight*, Vol. 27, No. 4, April, 1947, p. 32.

The essentials for improved safety of operations, landings, and take-offs under all weather conditions are discussed. It is necessary to have airports and ground aids that can equal the performance of modern transport aircraft.

Airways and Traffic Control

Airway Aids for Tomorrow's Pilot. Theodore P. Wright. *Air-Sea Safety*, Vol. 2, No. 4, April, 1947, pp. 32–38, illus.

A review of the progress that is being made in the modernization of civil airways by improving landing aids, radar, approach lighting, fog dispersal, radio communications and ranges, long-range navigation facilities, and distance indicators.

Integrated Landing Aids. Ray D. Kelly and Robert L. Champion. *Preprint, S.A.E. National Aeronautic Meeting (Spring)*, New York, April 9–11, 1947. 18 pp., figs. 14 references.

Three basic units comprise the equipment for landing aircraft under conditions of limited visibility: (1) electronic low-approach aids; (2) a suitable method of marking the final approach and runway areas; and (3) a fog-dispersal system for extreme conditions. The first group includes instrument landing systems and/or ground controlled approach equipment, one or a combination of the two being used to control incoming traffic and guide the pilot to a landing. The second group includes high-intensity, wide-angle approach lights, and runway markers for low visibility. The third unit is the equipment for dispelling fog by heat, known as FIDO. The various equipment and experiences in using them at the Landing Aids Experiment Station at Arcata, Calif., are described.

Landing Aids for All-Weather Flights. *Airports*, Vol. 11, No. 4, April, 1947, pp. 14, 15, illus.

The general principles of Microwave Early Warning (MEW) search radar and height-finder equipment for ground control, under development by The Airborne Instruments Laboratory, are explained, as well as the operation of the I.L.S. and G.C.A. systems.

Radar in Civil Aviation. F. R. Willis. *Flight*, Vol. 51, No. 1995, March 20, 1947, pp. 242–245, illus. (Extended abstract of a paper.)

The qualities and uses of many of the radio and radar navigation aids available are summarized, and possible future applications of the equipment are considered. For purposes of analysis the equipment is grouped into final-approach aids, short-distance aids, and long-distance aids. The operating principles of equipment in each group are discussed.

Air Navigation Facilities. William A. M. Burden. *SAE Journal*, Vol. 55, No. 4, April, 1947, pp. 17–19. (Extended abstract of an address.)

Plan All-Weather Air Safety. III. Ronald A. Keith. *Canadian Aviation*, Vol. 20, No. 4, April, 1947, pp. 22, 23, 62, figs.

A brief review of equipment used for instrument control of flight and navigation, traffic control, and landing aids, as designed for international air traffic and especially as employed in Canada.

Atomic Energy

Atom Bomb. *Air Affairs*, Vol. 1, No. 3, March, 1947, pp. 324–418.

A collection of twelve articles: Introduction, William F. Ogburn; Physical Damage at Hiroshima and Nagasaki, H. L. Bowman; Antipersonnel Effects, Stafford L. Warren; Ground Forces, A. C. McAuliffe; Sea Forces, W. H. P. Blandy; Air Forces, William E. Kepner; Social Effects, Lewis Mumford; World Politics, Quincy Wright; U. S. Politics: A Legislator, Brien McMahon; U. S. Politics: A Scientist, P. Morrison; Morals, Elbert D. Thomas; Comment, Henri Bouché.

Comfort in Aircraft

Dimensional Requirements for Seats in R.A.F. Aircraft. G. M. Morant. *Gt. Brit., Flying Personnel Research Committee, Report No. 682*, February, 1947. 26 pp., diagrs. 11 references.

Factors governing the best form of seating equipment for aircraft in general include safety in forced landing; escape from the aircraft; efficiency in operations, for vision, mobility, and reach of controls; comfort, involving general posture, adequate support for the body, and ease in using controls; and suitability for users of all sizes. The physiologic characteristics of the human body were studied extensively to obtain average measurements and angular limits. Harness is effective in protecting the occupant by restraining him in the seat and preventing injury by impact, and also in facilitating motions, such as pushing pedals, by giving increased leverage. Seat positions resulting in the least discomfort during long flights have been found to contribute substantially to the success of flying missions. There are valid reasons for placing the seats for passengers and certain crew members in a rearward-facing position, to give greater protection in the event of impact. Extensive recommendations are set forth for the dimensions and location of passenger and crew seats.

Passenger Seats Can Be Comfortable. Charles W. Morris. *Preprint, S.A.E. National Aeronautic Meeting (Spring)*, New York, April 9–11, 1947. 17 pp., figs. 31 references.

Provision for adequate accommodations for persons of widely varying physical proportions during flights lasting from a few hours to an overnight journey entails the establishment of average dimensions for the height, width, depth, and length of cushions and arm-rests, reclining angles for seat backs, automatic mechanisms for adjustment to positions ranging from the erect to that for full relaxation and sleeping, ample foot space, and many other considerations. A solution is based on a combination of the features of the reclining-back chair and the rocking chair.

Give Them Air. George Herrick. *Air Transport*, Vol. 5, No. 4, April, 1947, pp. 37, 38, illus. The problems of adequate air conditioning of commercial aircraft at higher altitudes.

Reduce Noise Nuisance in Personal Planes. *SAE Journal*, Vol. 55, No. 4, April, 1947, pp. 44–47, illus. (Extended abstracts of two papers: The Propeller Aspect of Practical Problems in Reducing Noise in Personal Planes, Leslie J. Trigg (Cf. AER 3/47:79); Practical Problems in Reducing Noise in Personal Planes, B. J. Simons (Cf. AER 3/47:54).)

Control Systems

Twin Tail Surfaces. Leon Paul Lipsick. *Aero Digest*, Vol. 54, No. 4, April, 1947, pp. 70–72, 138, figs. 3 references.

The advantages and disadvantages of double vertical tail surfaces are outlined. Why the design provides good rudder control and increases the efficiency of the horizontal tail and elevator is explained. Design requirements and structural problems peculiar to twin vertical tail surfaces are analyzed in detail.

Automatons for Tomorrow's Aircraft. Hugo Schuck and Gordon Volkenant. *Preprint, S.A.E. National Aeronautic Meeting (Spring)*, New York, April 9–11, 1947. 6 pp.

A summary of automatic devices for control of engine power, comfort, safety, flight, and navigation which depend upon servomechanisms with elements of inertia, resistance, and elasticity.

The Analysis and Design of Servomechanisms. Herbert Harris, Jr. *The American Society of Mechanical Engineers,*

Transactions, Vol. 69, No. 3, April, 1947, pp. 267–280, figs. 10 references.

Through the use of transient solution methods, an analysis is made of the responses of several types of servomechanisms which are characterized by a servomotor load consisting principally of inertia and coulomb friction. The use of derivative and integral-type controls is discussed, and also the effect of response delays and limitations in torque.

Electrical Equipment

Adaptation of Automotive Electrical Equipment for Personal Aircraft. J. B. Hiday. *Preprint, S.A.E. National Personal Aircraft Meeting*, Wichita, May 1–2, 1947. 5 pp., figs.

By using light metals, special winding insulation, and reasonable changes in regulators, control equipment, drive mechanisms, and instruments, standard automotive electrical units can be varied to meet light-aircraft requirements and can be produced without special tooling.

Electrical Power and the Transport Airplane. E. P. Buckthal. *Preprint, S.A.E. National Aeronautic Meeting (Spring)*, New York, April 9–11, 1947. 5 pp.

Outlines the advantages of electric auxiliary power, traces its evolution, and advises on the selection of the proper system and units to meet the requirements of a particular type of airplane.

Airborne Power Station; Self-Contained Auxiliary Generating Plant for Large Aircraft; First 3-Phase A.C. System on the Shetland. *Flight*, Vol. 51, No. 1995, March 20, 1947, pp. 239, 240, illus.

Aircraft Limiters for Electrical Distribution. *Burndy Engineering Co., Inc., Bulletin No. 47F1*, Recd. May 6, 1947. 7 pp., illus.

The limiters are aircraft fuses designed for use in conventional 30-volt d.c. systems and the 120/208-volt, 400-cycle a.c. systems planned for more recent aircraft. They permit temporary overloads in the wires but clear promptly on short circuits. Graphs and tables showing the time-current characteristics and other specifications are included.

Littelfuse Products, Catalog No. 9. *Littelfuse, Inc.*, 1946. 24 pp., illus.

Contains descriptions and specifications of new developments, revisions, additions to the manufacturer's list of fuses, fuse mountings and circuit indicators, and recommendations for circuit protection.

Engine Parts and Accessories

New Methods in Valve Cam Design. Winston M. Dudley. *Preprint, S.A.E. National Aeronautic Meeting (Spring)*, New York, April 9–11, 1947. 31 pp., figs. 3 references.

A large number of actual valve motions were directly recorded, using a stroboscope or a high-speed camera. When these records were superposed on the theoretic valve motion as determined by the cam profile, it was seen that the chief cause of bad valve motion was flexibility in the linkage between cam and valve. Typical curves show how the actual valve motion at low and high speeds varies from the theoretic motion. The conventional cam design process fails because it assumes complete rigidity of the parts between cam and valve. Actually, in a large radial aircraft engine at take-off speed, the sum of forces due to inertia, valve-spring force, and gas pressure may be a ton or more, resulting in deflections of the order of $^1/_8$ in. at the valve. Some improvement can be obtained by stiffening the valve linkage but this will add weight and require increased force from the valve spring. A better approach to the problem is suggested. For any specified valve motion it is possible to calculate the cam profile which, acting through the flexible valve linkage and at a given speed, will cause such a motion to take place.

German and French Radiators and Oil Coolers for Aeronautical and Automotive Purposes. Fred M. Young. *Combined Intelligence Objectives Sub-Committee, Item No. 19, 21, 25, 26, 29, File No. 32-25.* 118 pp., illus. British Information Services, New York. $3.00.

Surface Discharge Plug Featured in Low Tension Ignition Research. *Aviation*, Vol. 46, No. 4, April, 1947, p. 64, figs.

Experiments at the Junkers Dessau plant reduced electric-system troubles encountered with higher engine outputs and increased altitudes. A surface discharge plug operating at 400–1,000 volts overcame the tendency of the spark to jump the insulation.

Righter Announces New Aircraft Engine Starter. *Righter Products Co., Release*, Recd. April 7, 1947. 5 pp., illus.

A mechanical, foot-operated starter designed for light airplanes is operated from the pilot's seat and is intended for use in flight as well as on the ground.

Welded Magnesium Tanks. III—Materials Inspection; Welding of Magnesium in Theory and Practice; Weld-Rectification; Protective Finishes. R. J. Cross. *Aircraft Production*, Vol. 9, No. 101, March, 1947, pp. 97–102, illus. (Cf. AER 4/47:47.)

Air and Oil Filtration. II—Production by Vokes of the Air-Intake Unit for the Bristol Hercules 100. *Aircraft Production*, Vol. 9, No. 101, March, 1947, pp. 111–114, illus. (Cf. AER 4/47:47.)

Latest Developments in Engine Bearings. II. P. M. Heldt. *Automotive and Aviation Industries*, Vol. 96, No. 7, April 1, 1947, pp. 34–37, 62, 64, illus. (Cf. AER 5/47:37.)

Practices in the manufacture of silver bearings for Wright aircraft engines are reviewed. Details are given about bearing inspection methods, load-capacity tests, fatigue tests, the fatigue resistance of alloys, and wear, corrosion, and cavitation tests.

Engines—General

The Combination of Internal-Combustion Engine and Gas Turbine. K. Zinner. (*Verein Deutscher Ingenieure, Zeitschrift*, Vol. 88, No. 19-20, May 13, 1944, pp. 245–256.) *U.S., N.A.C.A., Technical Memorandum No. 1141*, April, 1947. 45 pp., figs. 41 references.

Combination engines consisting of an internal-combustion engine, a turbine, and a compressor are compared with the simple gas turbine, and the current state (1944) of development of various types of gas turbines is reviewed. Applications of the principle include the exhaust-gas supercharging of four-stroke Diesel engines and Otto-cycle engines, two-stroke Diesel engines, and gas turbines with piston-type propellant-gas generators. Fuel consumption, weight-power ratio, and several other determining characteristics are discussed briefly.

American Aircraft Engines. *Western Flying*, Vol. 27, No. 4, April, 1947, pp. 78–104 (14 pp.), illus. Over 75 gas-turbine and reciprocating engines of 17 manufacturers are described.

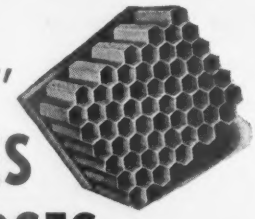
Engines, Gas Turbine

Increasing the Range of Axial-Flow Compressors by Use of Adjustable Stator Blades. John T. Sinnette, Jr. *Journal of the Aeronautical Sciences*, Vol. 14, No. 5, May, 1947, pp. 269–282, figs. 12 references.

A theory has been developed for resetting the blade angles to improve the performance at speeds and flows other than the design values and thus extend the useful operating range of the compressor. The theory is applicable to the resetting of both rotor and stator blades or to the resetting of the stator blades alone, and is based on the adjustment of the blade angles to obtain lift coefficients below the stalling point of the blades. Tests were made on the N.A.C.A. eight-stage axial-flow compressor with blade settings as designed; and with stator blades reset for 75 per cent of designed speed and for load coefficients of 0.48 and 0.65, respectively. The test results show that a substantial increase in the useful operating range can be obtained by adjustment of only the stator-blade angles. Considerable improvement in efficiency at compressor speeds appreciably below the design speed was obtained for both stator-blade resettings. A difference of 20 to 30 per cent in the peak-efficiency flows was obtained, which at high compressor speeds is about seven times the maximum flow range for any given blade setting.

Characteristics of Turbojet Engines at High Flight Speeds. C. A. Meyer. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 3, April, 1947, pp. 237–244, figs.

The present methods available and the future research necessary to solve some of the problems encountered are indicated. Problems considered include (1) the effect of high flight speed on the performance of engine components; (2) the effect of high flight Mach Number on the inlet diffuser and exhaust nozzle; (3) thermal-cycle effects causing changes in thrust and fuel consumption; (4) the effect of Reynolds Number on the performance of

A Honeycomb "Sandwich"  *helps*

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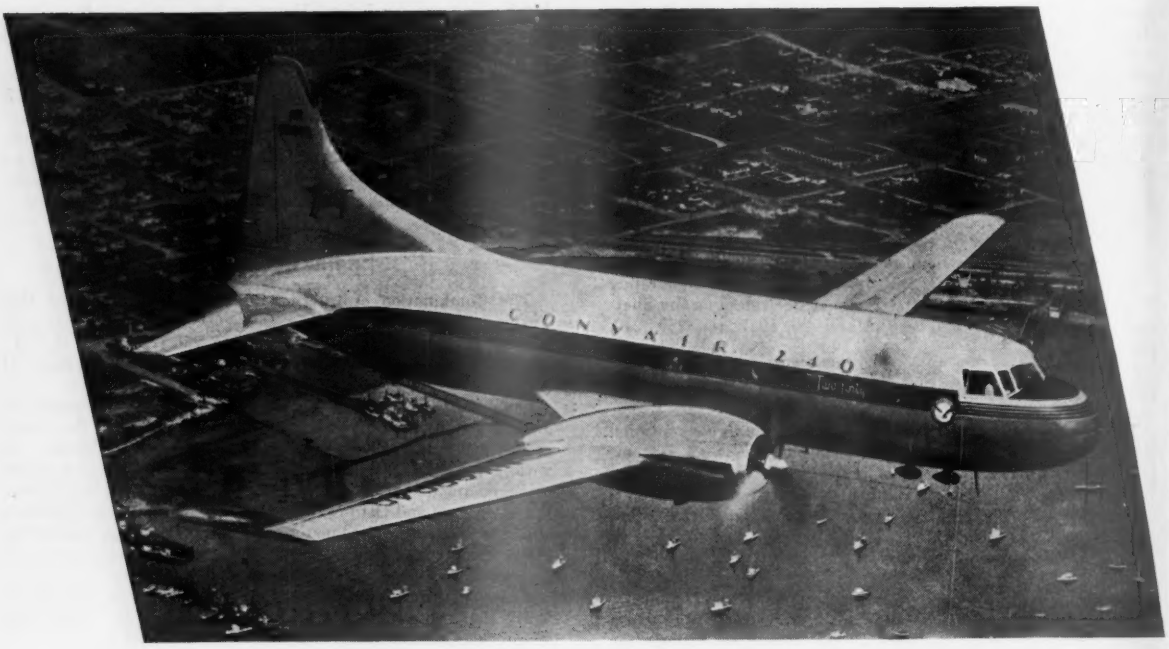

Convair 240's find favor fast. Already more than 160 have been ordered by domestic and foreign airlines. It is the first commercial transport to use auxiliary jet exhaust thrust for added speed. Other features include air-conditioning; heated wings, to prevent icing; pressurized cabin and reversible pitch props. Honeycomb is used throughout for flooring and shelving.

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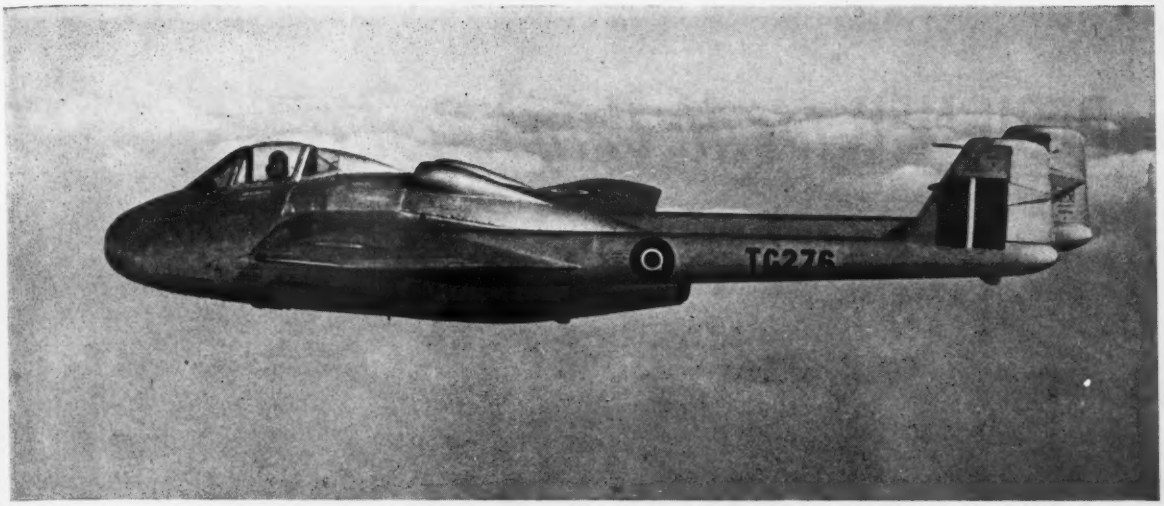

Latest de Havilland "Vampire," powered with a Rolls-Royce "Nene" engine, is known as the "Vampire Mark II."

engine components; (5) the variation of top temperature with flight conditions introducing a control problem.

Minutes of Axial Flow Compressor Meeting of June 26 on German Articles Primarily by Bruno Eckert and Group. *U.S., Bureau of Ships (Navy Dept.)*, 1946. 47 pp., figs.

The text of nine papers: Characteristic Numbers for Representing Compressor Performance and Nomenclature, Walter Doll; Losses in Axial Flow Compressors, John Talbert; Design Basis, J. Austin King; Choice of Optimum Pressure Coefficient Per Stage and the Influence of Blade Shape and Camber on This Coefficient, L. R. Woodworth; Blade Stagger and Shape Required to Satisfy the Predetermined Vector Diagram, F. Gardiner; Use of Cascade Tests, Airfoil Tests and Single State Tests for Determination of Certain Performance Factors, Hunt Davis; Matching of Stages, i.e., Establishment of the Values of ϕ, x, ν for Each Stage of a Multistage Compressor, Reeves Morrison; Supersonic Compressors, G. J. Fabian; and Correlation Between Performance and Design Features of Various German Axial Flow Compressors, Chester W. Smith. Summaries of translations of two German books are given: New General Theory of Multistage Axial Flow Machines, Walter Traupel; and The Flow Around Turbine and Compressor Blades, F. Weinig.

The Flow Through Axial Turbine Stages of Large Radial Blade Length. Eckert and Korbacher. (*Braunschweig, Luftfahrtforschungsanstalt Hermann Göring, ZWB/FB/1750*, February 18, 1943.) *U.S., N.A.C.A., Technical Memorandum No. 1118*, April, 1947. 44 pp., figs. 8 references.

Calculations are made for the effect on the flow in a turbine of the increase in pressure from the axis outward in the space between the stator and the rotor, for twisted and untwisted blades. Results are shown for stator blades without twist and with exit angles of 30° to 45°, and for rotor blades with and without twist. With a stator blading of 30° exit angle, a rotor blade operates with 50 per cent reaction at its outer end when equal pressure exists at its foot and when the blade length is 0.6 of the inner radius. The flow through the stage is first deflected toward the axis in the stator having blades without twist. That phenomenon is reversed in the rotor and somewhat overcompensated if the rotor blades also are without twist.

Axial-Flow Fan and Compressor Blade Design Data at 52.5° Stagger and Further Verification of Cascade Data by Rotor Tests. Seymour M. Bogdonoff and Eugene E. Hess. *U.S., N.A.C.A., Technical Note No. 1271*, April, 1947. 21 pp., figs. 2 references.

In an attempt to increase the accuracy of existing design charts and to obtain a measurement of their precision, additional cascade tests were conducted at 52.5° stagger on the NACA 65-410, 65-810, and 65-(12)10 blower-blade sections at solidities of 1.0 and 1.5, and tests were made in a test blower to obtain performance data in an actual rotating setup. Cross plots of data obtained show that, over a range of stagger from 44° to 65°, turning angles predicted from cascade tests are within $\frac{1}{2}$ per cent of those obtained from tests with a rotating setup.

Recent Results on High-Pressure Axial Blowers. B. Eckert, (*Verein Deutscher Ingenieure, Zeitschrift*, Vol. 88, No. 37-38 September 16, 1944, pp. 516–520.) *U.S., N.A.C.A., Technical Memorandum No. 1128*, April, 1947. 19 pp., figs. 3 references.

By using inlet ducts and careful airflow design in the individual parts, axial blowers will provide high efficiencies and high pressures. Studies of the hub shrouds showed that on the upstream side the semispherical form was the most favorable, and on the downstream side, for hub ratios greater than 0.5, the diffuser with increasing outer and hub diameter appeared to be promising. An empirically derived equation gives the effect of the radial clearance on the blower output, the relation giving the volumetric efficiency as a function of the relative clearance. Pressed-sheet blades gave practically equal efficiencies and outputs as light-metal streamlined blades.

What Are the Essential Requirements of a Gas Turbine Installation. Gaylord W. Newton. *Preprint, S.A.E. National Aeronautic Meeting (Spring)*, New York, April 9–11, 1947. 6 pp.

Covers the fundamental considerations involved in fitting a gas-turbine engine to an air frame, and discusses the provisions to be made for efficient operation, maintenance, and safety.

A Contribution to the Solution of the Gas Turbine Problem. I, II. A. J. R. Lysholm. *The Engineer*, Vol. 183, Nos. 4756, 4757, March 21, 28, 1947; pp. 240, 241; pp. 263, 264; figs. (Extended abstract of a paper.)

I. Early developments in gas turbines and the evolution of opinion regarding design principles are reviewed. Details are given about a method devised by the writer for solving the gas turbine problem. Instead of waiting for the development of special materials, the idea was to take available materials and to use a multiple-stage turbine with the highest attainable thermodynamic efficiency and low peripheral speeds at the inlet, in order to get low blade and disc stresses in these parts. The principle was embodied in the Bofors turbine built in 1934. **II.** Further experiments with gas turbine designs are discussed. Particulars are given about the Elliott-Lysholm marine turbine and its performance characteristics.

Turbine Engine Activity at Ernst Heinkel Aktiengesellschaft. L. P. Bamford and S. T. Robinson. *Combined Intelligence Objectives Sub-Committee, Item No. 5, File No. 23-14*, May, 1945. 69 pp., figs. British Information Services, New York. $1.90.

Heinkel-Hirth TL Gas Turbine Engine. J. W. Adderley, E. Saddler, and S. T. Robinson. *Combined Intelligence Objectives Sub-Committee, Item No. 5, File No. 21-5.* 24 pp., illus. British Information Services, New York. $0.70.

Gas Turbine Development by B.M.W. P. R. Price. *Combined Intelligence Objectives Sub-Committee, Item No. 5, File No. 26-30.* 35 pp., figs. British Information Services, New York. $1.30.

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DEVELOPING FLIGHT TO MEET THE FUTURE

Theseus Air Testing. *Flight*, Vol. 51, No. 1996, March 27, 1947, pp. 270–273, illus. (Cf. AER 1/47:45.)

Information is given about two Series TH.II turbine propeller units installed in an Avro Lincoln aircraft for testing. An automatic propeller pitch control maintains constant speed ratio between the two turbines. Fuel consumption and power output figures for the Series TH.II, without heat exchanger, are compared with those for the Series TH.21 equipped with a heat exchanger. Important specifications and preliminary performance data for both engines are tabulated.

Service Type Test of "Theseus" Propeller-Turbine Aero-Engine. *Engineering*, Vol. 163, No. 4237, April 11, 1947, p. 283. (Cf. preceding abstract.)

Theseus-Lincoln Flight Programme. *The Aeroplane*, Vol. 72, No. 1868, March 28, 1947, pp. 312–314, illus. (Cf. AER 1/47:45.)

The De Havilland "Ghost." *Aero Digest*, Vol. 54, No. 4, April, 1947, p. 81, illus.

French and British Turbojets Show New Features. *Aviation*, Vol. 46, No. 4, April, 1947, pp. 42, 43, illus. (Cf. AER 4/47:48.)

The Rateau SRA French axial-flow turbojet unit, utilizing a split airflow, in which part of the total intake by-passes the turbine, delivers 2,200 lbs. static sea-level thrust for a specific fuel consumption of 1.05 lbs. per hr. per lb. thrust. The engine weight is high compared with full-compression engines, but on long hauls the low fuel consumption would tend to offset this. The de Havilland Ghost centrifugal turbine, which develops 5,000 lbs. thrust, also is described.

Engines, Reciprocating

A Review of Service Experience with Aircraft Power Plant Installations. D. L. Posner. *Paper presented at I.A.S. Fourth Annual Personal Aircraft Meeting*, Detroit, May 26–27, 1947. (For abstract see "I.A.S. Briefs" on page 24 of this issue, June, 1947.)

An Analysis of the Factors That Affect the Exhaust Process of a Four-Stroke-Cycle Reciprocating Engine. John D. Stanitz. *U.S., N.A.C.A., Technical Note No. 1242*, April, 1947. 35 pp., figs. 7 references.

If variation in exhaust-valve flow coefficient with engine crank angle can be approximated by a sine curve and if the effects of exhaust pipes and manifolds can be neglected, the significant factors affecting the exhaust process are the gas-velocity parameter, the initial gas-pressure ratio, and the effective exhaust-valve closing angle. For most of the practical operating conditions no optimum intake to exhaust-valve area ratio exists, and the intake-manifold pressure has no significant effect upon the exhaust process. From the recommended gas-velocity parameter, equal to 0.325, the exhaust-valve area can be calculated for any given piston speed and area. Late closing of the exhaust valve is the most effective method of keeping cylinder pressure low near the end of the exhaust stroke, as the value of the gas-velocity parameter is increased.

Effect of Exhaust Pressure on the Performance of an 18-Cylinder Air-Cooled Radial Engine with a Valve Overlap of 62°. Leroy V. Humble, Tibor F. Nagey, and David S. Boman. *U.S., N.A.C.A., Technical Note No. 1232*, March, 1947. 44 pp., illus. 4 references.

The R-2800-57-C engine was equipped with a conventional exhaust collector ring. The dynamometer-stand investigation covered engine speeds of 1,400–2,600 r.p.m.; inlet-manifold pressures of 30–50 in. of mercury absolute; fuel-air ratios of 0.063, 0.069, 0.085, and 0.100; and spark settings of 20° and 35° before top center. Exhaust pressure was varied from about 6 in. of mercury absolute to about 20 in. of mercury above inlet-manifold pressure. At increased exhaust pressure and at constant values of the other variables, inlet-manifold and average cylinder-head temperature increased, and engine power and charge-air flow decreased; exhaust-gas temperature reached a peak value at an exhaust pressure of about 0.8 of inlet-manifold pressure.

The Linkage by the Escalator Process of Crankshaft-Propeller Geared Systems. J. Morris. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2082*, April, 1944. 10 pp., figs. 5 references. British Information Services, New York. $0.60.

In dealing with torsional vibration problems where a large number of crankshaft masses is involved, including branch-geared subsystems, the calculation of the engine frequencies becomes laborious. It is possible to split the main system into parts for each of which the solution is simple, using a method in which the "escalator" technique is developed to exploit admittance methods for shortening the labor. Formulas are established for the whole system in terms of the solutions of the simpler constituent systems, and then the units are reunited by the elimination of the linking parameters. Using equations of motion based on the polar moments of inertia of the engine masses and the frequency vibration of the engine system, a final equation is derived involving the solution of two third-order equations for each of which one root is zero.

Influence of Heat Transfer on the Measurement of Ignition Delay by Adiabatic Compression. F. A. F. Schmidt and Heinz Koppe. (*Garmisch-Partenkirchen, ZWB/DVL/1946*, July, 1946.) *U.S., Army Air Forces, Translation No. F-TS-977-RE*, March, 1947. 15 pp., figs.

A mathematical analysis of the volume-temperature changes in experimental combustion chambers due to the impossibility of creating an ideal, fully adiabatic compression, and the effect of these changes on the ignition timing.

Problems of Helicopter Power Plants. Robert Insley. *Preprint, S.A.E. National Personal Aircraft Meeting*, Wichita, May 1–2, 1947. 10 pp., table.

How the functional requirements of helicopter engines differ from those for conventional airplanes is explained. Design is discussed with particular attention to weight reduction, general configuration, cooling requirements, operational characteristics, and special problems of dynamics.

High Altitude Oxygen Boost for Aircraft Engines. Francis Masi, Ernest F. Flock, and Robert A. Grosselfinger. *Aviation*, Vol. 46, No. 4, April, 1947, pp. 54, 55, illus.

A review of research work carried out in the development of a system for the Navy which permits emergency power increases of nearly one-third at above-supercharger heights. A diagram shows the liquid-oxygen supercharging system for the Pratt & Whitney R-2800-8 engines. Curves reveal the results of ground tests of this engine at conditions simulating level flight at 26,000-ft. altitude.

Fuel Injection Versus Carburetion for Personal Airplane Engines. G. M. Lange. *Preprint, S.A.E. National Personal Aircraft Meeting*, Wichita, May 1–2, 1947. 35 pp., figs. 9 references.

The intake metering injection system, one of the four methods in current use, incorporates intake metering of the fuel with a mechanical linkage between the fuel and air throttle lever arms, the fuel flowing through a metering valve. The amount of fuel metered to the pumping plunger is dependent upon the supply-pump pressure and the throttle position. The pump throttle is calibrated and linked to the air throttle in the correct relationship to provide the proper amount of metered fuel for the corresponding metered airflow over the operating range of the engine. Advantages include elimination of manifold icing, better idling, faster acceleration, lower maximum cylinder-head temperatures, better fuel economy, increased power, simplified cooling, and flatter engine design.

Fuel Injection for Low-Horsepower Aircraft Engines. George M. Lange. *SAE Journal*, Vol. 55, No. 4, April, 1947, pp. 48–52, figs. (Extended abstract of a paper: Fuel Injection for Light Aircraft.) (Cf. AER 3/47:61.)

Engines for Light Aircraft. D. S. King. *Preprint, S.A.E. National Personal Aircraft Meeting*, Wichita, May 1–2, 1947. 8 pp., figs.

Despite the development of reaction-propulsion power plants, it is believed that light aircraft will continue to be powered by reciprocating engines for some time to come. Some of the factors affecting power-plant requirements for this type of aircraft are discussed.

Experiments with Converted Automotive Engines for Light Aircraft Power Plants. Joseph C. Funk. *Preprint, S.A.E. National Personal Aircraft Meeting*, Wichita, May 1–2, 1947. 4 pp.

A review of problems encountered by the Funk Aircraft Company to alter (beginning in 1936) Ford Model A and B automobile engines for light aircraft use.

Radial Review: A Stock-Taking of the Newest Bristol Hercules and Centaurus Engines. *Flight*, Vol. 51, No. 1998, April 10, 1947, p. 319.

Aircraft Engine Factories in the Paris Area. M. Lambert. *Combined Intelligence Objectives Sub-Committee, Item No. 25, 26, File No. 11–6.* 17 pp. British Information Services, New York. $0.55.

Engines, Rocket

Gaging Rocket-Engine Forces and Flows. George P. Sutton. *Aviation*, Vol. 46, No. 4, April, 1947, pp. 46–48, figs.

The physical quantities, which are usually measured to describe the test-stand performance of a rocket, include thrust and reaction forces; the flow of propellants; pressures; temperatures; the velocities of jet gases; and the chemical composition, size, and shape of the flame. Each of these is discussed, together with the appropriate measuring devices. Schematic drawings show a rocket engine with the locations for measuring basic quantities; a thrust-jack test stand; and a hydraulic thrust-jack for measuring rocket forces. A typical oscillogram of six basic rocket-engine forces and measurements is shown.

German 21 cm. R-LG Rocket (Flare). A. B. Meinel. *Combined Intelligence Objectives Sub-Committee, Item No. 2, 4, 17, File No. 32-114*, August, 1945. 9 pp., figs. British Information Services, New York. $0.35.

Fire Prevention

Smoke-Spotting "Eyes" Give Plane-Fire Alert. John H. Cantlin. *Aviation*, Vol. 46, No. 4, April, 1947, pp. 44, 45, illus.

Fires originating in cargo and baggage spaces involve relatively slow-burning carbonaceous materials and therefore require a different method of detection than is employed for flammable liquids such as oil and gasoline. Studies made by engineers of the C-O-Two Fire Equipment Company, working with American Airlines, have resulted in the development of two kinds of smoke detectors, a convection type and a tube type.

Flight Testing and Performance

The Correlation of Wind Tunnel and Flight Test Stability and Control Data for an SB2C-1 Airplane. Marion T. Hockman and Robert E. Eisiminger, Jr. *Curtiss-Wright Corp.* (For abstract see "I.A.S. Briefs" on page 25 of this issue, June, 1947.)

Sideslip Angles and Vertical-Tail Loads in Rolling Pull-Out Maneuvers. Maurice D. White, Harvard Lomax, and Howard L. Turner. *U.S., N.A.C.A., Technical Note No. 1122*, April, 1947. 35 pp., figs. 10 references.

Expressions are derived for calculating theoretically the sideslip angles in such maneuvers as abrupt rudder-fixed rolls from accelerated flight, and numerical solutions are obtained for a wide enough range of variables to permit construction of design charts. Comparison of the maximum sideslip angles obtained from the design charts and from flight tests, with those obtained by using a greatly simplified expression, indicates sufficiently close agreement to warrant use of the simplified expression for first approximations in predicting sideslip angles and vertical-tail loads occurring in rolling pull-out maneuvers for conventional ailerons. An approximate method for treating cases of nonlinear directional-stability characteristics is presented which gives reasonably good results. The vertical-tail loads measured on one airplane in rolling pull-out maneuvers corresponded closely with those calculated by the simplest methods when the actual sideslip angles attained were applied.

Wind-Tunnel Investigation of the Effect of Power and Flaps on the Static Longitudinal Stability Characteristics of a Single-Engine Low-Wing Airplane Model. Arthur R. Wallace, Peter F. Rossi, and Evalyn G. Wells. *U.S., N.A.C.A., Technical Note No. 1239*, April, 1947. 125 pp., figs. 10 references.

Tests were made to determine the longitudinal stability characteristics with and without power, with flaps neutral, with a full-span single-slotted flap, and with a full-span double-slotted flap. The horizontal tail incorporated a leading-edge slot for the flap-deflected conditions and was placed high to avoid the slipstream. With flaps deflected, lift increments were increased by 0.16 for the single-slotted flap and 0.42 for the double-slotted flap when power was applied. Power also increased the slope of the untrimmed lift curves (increase of 0.034 for the double-slotted-flap condition). Deflecting the flaps increased longitudinal stability slightly. The windmilling propeller shifted the neutral point forward from 1 to 5 per cent mean aerodynamic chord. The effect of power on longitudinal stability was small except for an erratic effect with the single-slotted flap and at high

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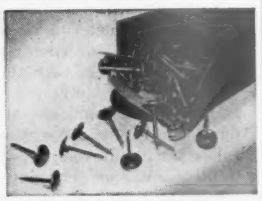

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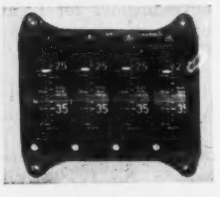

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lift coefficients with the double-slotted flap. The stabilizer nose slot improved the stability and delayed the tail stall, but reduced the elevator effectiveness. Sufficient control was provided by the tail as tested.

Summary of V-G Records Taken on Transport Airplanes from 1932 to 1942. Walter G. Walker. *U.S., N.A.C.A., Restricted Bulletin (Wartime Report No. L-453)*, July, 1942. 15 pp., figs. 6 references.

Limitations of Lifting-Line Theory for Estimation of Aileron Hinge-Moment Characteristics. Robert S. Swanson and Clarence L. Gillis. *U.S., N.A.C.A., Confidential Bulletin No. 3L02 (Wartime Report No. L-281)*, December, 1943. 11 pp., figs. 12 references.

Some Notes on the Determination of the Stick-Fixed Neutral Point from Wind-Tunnel Data. Marvin Schuldenfrei. *U.S., N.A.C.A., Restricted Bulletin No. 3I20 (Wartime Report No. L-344)*, September, 1943. 18 pp., figs. 4 references.

Effect of Changes in Aileron Rigging on the Stick Forces of a High-Speed Fighter Airplane. Harry E. Murray and S. Anne Warren. *U.S., N.A.C.A., Restricted Bulletin No. L4E11 (Wartime Report No. L-289)*, May, 1944. 12 pp., figs. 5 references.

Determination of the Effect of Wing Flexibility on Lateral Maneuverability and a Comparison of Calculated Rolling Effectiveness with Flight Results. Sidney M. Harmon. *U.S., N.A.C.A., Advance Restricted Report No. 4A28 (Wartime Report No. L-525)*, January, 1944. 25 pp., figs. 10 references.

Effect of Changes in Aspect Ratio, Side Area, Flight-Path Angle, and Normal Acceleration on Lateral Stability. M. J. Bamber. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-403)*, December, 1942. 26 pp., figs. 10 references.

A Study of the Effect of Adverse Yawing Moment on Lateral Maneuverability at a High Lift Coefficient. Leo F. Fehlner. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-465)*, September, 1942. 17 pp., figs. 4 references.

A Study of the Effects of Vertical Tail Area and Dihedral on the Lateral Maneuverability of an Airplane. Leo F. Fehlner. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-347)*, October, 1941. 23 pp., figs. 6 references.

Flight Tests of Various Tail Modifications on the Brewster XSBA-1 Airplane. II—Measurements of Flying Qualities with Tail Configuration Number Two. W. H. Phillips and H. L. Crane. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. L-598)*, December, 1943. 40 pp., illus. 2 references.

Measurement of Flying Qualities of a de Havilland Mosquito F-8 Airplane (AAF No. 43-334960). I—Lateral and Directional Stability and Control Characteristics. H. L. Crane, D. B. Talmage, and W. E. Gray, Jr. *U.S., N.A.C.A., Memorandum Report No. L5D19 (Wartime Report No. L-593)*, May, 1945. 67 pp., figs. 1 reference.

Measurements of the Flying Qualities of a Supermarine Spitfire VA Airplane. William H. Phillips and Joseph R. Vensel. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-334)*, September, 1942. 51 pp., illus. 3 references.

Stalling Characteristics of the Supermarine Spitfire VA Airplane. J. R. Vensel and W. H. Phillips. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-353)*, September, 1942. 27 pp., illus. 1 reference.

Fuels

A Spectrophotometric Method for Identification and Estimation of Alkylnaphthalenic-Type Hydrocarbons in Kerosene. Alden P. Cleaves and Mildred S. Carver. *U.S., N.A.C.A., Technical Note No. 1243*, April, 1947. 23 pp., figs. 12 references.

The method is based on comparison of the ultraviolet spectra of several naphthalenic compounds, regarded as typical standards, with the spectra of cuts of a kerosene or with the spectrum of the whole kerosene.

Gliding and Soaring

Steel Tube Fuselages in Gliders and Soaring Planes. N. J. Hoff. *Soaring*, Vol. 11, No. 1-2, January-February, 1947, pp. 7–9, diagrs.

The virtual absence of welded steel-tube fuselages in German types and their preferred use in American gliders and soaring planes are due to the differences in the historic development of gliding and soaring, the general level of mechanical skill, and the average income of the individual in the two countries. Perhaps the greatest advantage of the welded steel-tube fuselage is its excellent behavior in forced landings. Better streamlining can be obtained with a pseudo framework fuselage consisting of longitudinals, transverse ring frames, and surface bracing elements. The forces in the pseudo framework cannot be calculated as easily as in the conventional framework fuselage since it is a highly redundant structure, but the structural gains should offset the added work of stress analysis.

The Trend of Sailplane Design. I. L. P. Moore. *Sailplane and Glider*, Vol. 15, No. 4, April, 1947, pp. 6, 7, fig.

Based on the theory that for cross-country performance the sailplane should be designed for high cruising speed at optimum glide angle, rather than for low sinking speed, the requirements for a single-seater are discussed.

The Short Nimbus. *The Aeroplane*, Vol. 72, No. 1869, April 4, 1947, p. 329, illus. (Cf. AER 2/47: 51.)

Design for Power Soaring. E. H. Rowley. *Preprint, S.A.E. National Personal Aircraft Meeting*, Wichita, May 1–2, 1947. 3 pp.

Design details of an experimental power unit, removable in the manner of an outboard motor and adaptable to existing sailplanes.

Test-Flying a Tailless Glider. R. Kronfeld. *The Aeroplane*, Vol. 72, No. 1870, April 11, 1947, pp. 367–369, illus. (Cf. AER 12/46: 55.)

Following a description of the experimental General Aircraft Type 56, built in 1944 to obtain general design data on tailless aircraft, details are given about preliminary flight tests and test results, dealing with control forces, trim, stability, and other characteristics.

Guided Missiles

Fairey's First Guided Missile. *Flight*, Vol. 51, No. 1999, April 17, 1947, pp. 344, 345, illus.

Some details of the "Stooge" radio-controlled projectile, first designed to be a countermeasure to the Japanese suicide bomber. The missile is of monoplane design, without sweepback, has conventional elevators and a fixed vertical fin, and is powered by four 5-in. solid fuel rockets. Length is slightly over 7 ft., gross weight, 738 lbs., and speed over 500 m.p.h. Operation of the rocket engines and the control system is explained in general.

Systematic Wind-Tunnel Measurements on Missiles. O. Walchner. (*Lilienthal-Gesellschaft für Luftfahrtforschung, Bericht Nr. 139*, pp. 29–37.) *U.S., N.A.C.A., Technical Memorandum No. 1122*, March, 1947. 23 pp., figs. 1 reference.

The small, high-speed wind tunnel at Göttingen was fitted with a silica-gel filter to provide dry air, and nonrotating missile models were tested at Mach Numbers ranging from 1.2 to 3.2 to determine the center of pressure, the air-force components, the effects of projectile oscillations, and others. Measurements were obtained of the variation with Mach Number of the normal-force coefficient slope, the distance of the center of pressure from the base of the missile, the drag coefficients for axial flow, changes due to angle of attack, ratio of static pressure to dynamic pressure, and other factors, using models of various shapes and dimensions. Comparisons of drag coefficient were made with the results obtained from firing tests.

Hydraulic Equipment

The Design of German Aircraft Hydraulic Systems, Fuel Systems and Fuel System Components and Accessories. Robert H. Davies and Lester J. Henderson. *Combined Intelligence Objectives Sub-Committee, Item No. 5, 25, 26, File No. 31-41.* 439 pp., figs. British Information Services, New York. $9.65.

Some Applications of Hydraulics to High Speed, Rotary Drives for Aircraft Accessories. W. W. Thayer. *Preprint, S.A.E.*

Cessna's latest Model 195, powered with a 300-hp. Jacobs engine.

National Aeronautic Meeting (Spring), New York, April 9–11, 1947. 16 pp., figs. 14 references.

Ice Prevention

Basic Icing Research by General Electric Company, Fiscal Year 1946. *U.S., Army Air Forces, Technical Report No. 5339*, January 24, 1947. 201 pp., figs.

Contains eleven complete reports: (1) Final Report on Icing Research up to 1 July 1946, (2) Report on General Electric Cloud Meter (Plane Model), (3) Demountable Rotating Multicylinders for Measuring Liquid Water Content and Particle Size of Clouds in Above and Below Freezing Temperatures, (4) The Liquid Water Content of Summer Clouds on the Summit of Mt. Washington, (5) Heat Requirements for Instruments and Air Foils During Icing Storms on Mt. Washington, (6) The Preparation and Use of Water Sensitive Coatings for Sampling Cloud Particles, (7) A Heated, Vaned Pitot Tube and Recorder for Measuring Air Speed Under Severe Icing Conditions, (8) The Use of High Speed Model Propellers for Studying De-Icing Coatings at the Mt. Washington Observatory, (9) Effect of Impurities in Water on Ice Adhesion, Part 1, (10) Effect of Impurities in Water on Ice Adhesion, Part 2, and (11) The "Peel Off" Mechanical Wing De-Icer. Reports 1–8 were written by Vincent J. Schaefer and reports 9–11 by Robert Smith-Johannsen.

Wind-Tunnel Investigation of Icing of an Engine Cooling-Fan Installation. James P. Lewis. *U.S., N.A.C.A., Technical Note No. 1246*, April, 1947. 39 pp., illus.

An investigation was made of the icing characteristics and means of ice protection of a typical radial-engine cooling-fan installation. Reduction in airflow below the minimum value required for engine cooling occurred within 2 min. and complete stoppage of the cooling airflow through the fan assembly occurred in as little as 5 min. under normal icing conditions. Steam deicing was found to be effective for the cowling lip and inlet duct. Alcohol deicing of the fan blades and stator vanes was found to be unsatisfactory. Electrical heat deicing of the fan blades was found to be effective but deicing of the stator vanes was not completely effective at the power densities investigated.

Ice Accretion on Aircraft. P. M. A. Burke. *Ireland, Meteorological Service, Dublin, Technical Note No. 5 (Advance Issue)*, March 16, 1944. 15 pp., figs. 6 references.

A general discussion of the physical processes involved, avoiding more complex theoretic aspects. The concept of icing zones, the various types of icing, countermeasures, and the allocation of flying heights in accordance with the distribution of icing conditions are explained.

An Investigation of a Thermal Ice-Prevention System for a Cargo Airplane. VIII—Metallurgical Examination of the Wing Leading-Edge Structure After 225 Hours of Flight Operation of the Thermal System. Maxwell Harris and Bernard A. Schlaff. *U.S., N.A.C.A., Technical Note No. 1235*, April, 1947. 17 pp., illus. 15 references.

Specimens of Alclad 24S-T aluminum-alloy sheet were examined for the extent of corrosion and for changes in tensile strength as a result of aging of the aluminum alloy by the elevated temperatures. Only minor corrosion and no impairment of tensile strength were present. In the section of the system where the heated air entered there was a marked increase in yield strength accompanied by a decrease in elongation, and a slight gain in ultimate strength. Microphotographs show the extent of corrosion and the effect of temperature on the microstructure of the alloy.

Flight Investigation of an NACA Ice-Detector Suitable for Use as a Rate-of-Icing Indicator. R. R. Gilruth, J. A. Zalovcik, and A. R. Jones. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-364)*, November, 1942. 19 pp., illus.

A Flight Investigation of the Ice-Prevention Requirements of the United States Naval K-Type Airship. Wesley H. Hillendahl. *U.S., N.A.C.A., Memorandum Report No. A5J19a (Wartime Report No. A-4)*, October, 1945. 53 pp., illus. 2 references.

Instruments—General

Instrument Panel Lighting. John W. Knoll and Nicholas Ivanovic. *Aero Digest*, Vol. 54, No. 4, April, 1947, pp. 68, 69, illus.

Important requirements for judging the effectiveness of instrument-panel illumination are a total absence of light leaks and spurious reflections; unimpairment of night vision, par-

ticularly dark adaptation; uniform distribution of light; clear visibility of instruments; minimum of installation and servicing problems. Two types of panels using red indirect lighting, developed by the Naval Air Material Center, one for a night bomber trainer and the other for a night fighter are described.

Hermetically Sealing Aircraft Instruments and Control Components. W. A. Reichel. *Preprint, S.A.E. National Aeronautic Meeting (Spring)*, New York, April 9–11, 1947. 5 pp.

Methods based on fusing platinum to glass, soldering the joint, filling the container with a dry neutral gas such as helium, hydrogen, or nitrogen, and providing means for transmitting motion for adjustments without disturbing the seal.

Instruments, Engine

Rating Fuels with Knockometer. P. J. Costa and J. W. Wheeler. *SAE Journal*, Vol. 55, No. 4, April, 1947, pp. 27–29, 37, illus. (Extended abstract of a paper: The Knockometer—A New Instrument for Fuel Rating.)

An electrical instrument for rating the detonation of a fuel operates as follows: (1) A vibration pickup attached to the exterior of the cylinder head transforms the cylinder-head vibrations into electrical impulses. (2) Unwanted vibrations are eliminated by means of a commutator, which selects the pickup output voltage caused by combustion vibrations only. (3) The pickup output is amplified to a level suitable for use with the indicator desired. The operation of two models is described: the KM-1, designed for use in conjunction with the CFR-F-4 supercharge procedure for rating aviation fuels, and the KM-3, designed to replace the bouncing pin used with the CFR-EF-2 motor test procedure for automotive fuels.

Instrumentation for the Development of Aircraft Power Plant Components Involving Fluid Flow. S. J. Markowski and E. M. Moffatt. *Preprint, S.A.E. National Aeronautic Meeting (Spring)*, New York, April 9–11, 1947. 18 pp., figs. 8 references.

Seven independent variables must be determined for steady-state fluid flow: gas composition, pressure, temperature, velocity magnitude, velocity yaw angle, velocity pitch angle, and turbulence. The best temperature probe is one that minimizes the overall error from velocity, radiation, and conduction. Other deviations in temperature measurement are explained and expressions are given for calculating them. Micro-pitot-static tubes, the Kiel probe, the yaw probe, and the three-dimensional probe are described. Miscellaneous instruments include turbulence and pulsating-flow probes, gas-sampling tubes, combination instruments, and traversing devices, all of which are explained, together with the methods of calibration.

Instruments, Flight

Position Error of a Machmeter. H. W. Sibert. *Journal of the Aeronautical Sciences*, Vol. 14, No. 5, May, 1947, pp. 283, 284.

The A.A.F. Machmeter is an instrument with an airtight case containing two diaphragm capsules, one of which is evacuated and the other receives the pressure from the opening of an ordinary air-speed head. A simple formula is given for calculating the position error of such an instrument in terms of the Machmeter reading corrected for instrument error, the altimeter position error, and the standard-atmosphere density and pressure ratios corresponding to the altimeter reading corrected for instrument error.

Angle of Attack Indicator. *Square D Co., Kollsman Instrument Div., Release*, May 3, 1947. 11 pp., diagrs.

A vane exposed to the free air stream or relative wind measures the direction of the stream in the up-and-down sense. A geared-up self-synchronous motor indicator in the cockpit shows the angle between flow direction and some arbitrarily chosen reference line, such as the airplane's longitudinal axis or its mean chord. The instrument serves as a continuously acting stall-warning device. Since the approach condition is a function of angle of attack, the indicator can be used during a landing approach. An efficient flight condition can be maintained by keeping the needle of the instrument at a specified figure, adjusting the power so that the flight path is level. The instrument is useful also in measuring gross weight and predicting landing speed.

Instruments, Meteorological

A New Method of Measuring Relative Humidity. Fred Lichtgarn. *Instruments*, Vol. 20, No. 4, April, 1947, pp. 336–338, illus.

Various methods used to measure humidity are reviewed and their weaknesses noted. Experiments were conducted with humidity-responsive elements in the form of dissimilar metals separated by an absorber that acted also as an insulator, so that a weak voltage was generated and gave a measure of the water vapor. Elements made from iron and chromium oxides mixed with clay and kaolin performed satisfactorily and held their calibration for a sufficient period.

125 Automatic Electronic Ceilometers Being Produced for the Army and Navy. *General Electric Co., Release*, April 21, 1947. 3 pp.

The Ceilometer is an automatic electronic device that provides weather data as a flight-safety aid by accurately and continually measuring the distance from ground to clouds. It consists of a pulsating light device that throws a beam, invisible to the human eye during daylight hours, vertically into the sky. A detector unit, placed 1,000 ft. from the projector, detects the "scatter energy" produced on cloud layers dense enough to reflect and scatter the beam. This information, as well as the distance between cloud bank and ground, is transmitted to a recording device.

German and Japanese Radio Sondes. I. Project No. DE-25. *U.S., Army Air Forces, Technical Report No. F-TR-1134-ND*, April, 1947. 30 pp., illus.

Line-Powered Interval Timers. Ronald L. Ives. *American Meteorological Society, Bulletin*, Vol. 28, No. 3, March, 1947, pp. 144–148, illus.

Theory and Description of a Gradient Wing Computer. Mariano Doporto. *Ireland, Meteorological Service, Dublin, Technical Note No. 7 (Advance Issue)*, December 12, 1945. 20 pp., figs.

The computer utilizes the values of the geostrophic wind, the estimated speed and direction of the pressure system, and the radius and type of curvature of the isobars, for each required zone. A detailed mathematical explanation of the theory on which the computer operates is accompanied by a physical description and operating instructions.

Insurance, Safety, and Rescue

The Air Can Be Safer. T. P. Wright. *The Atlantic Monthly*, Vol. 179, No. 4, April, 1947, pp. 37–41.

A discussion of aircraft accidents and their causes, and problems connected with the development of the C.A.A. safety program. The value of various safety aids, including radar, is considered, and the importance of modernizing airports is pointed out.

International Air Safety. *International Air Transport Association, Bulletin*, April, 1947, p. 1.

Records of 60 scheduled international air-transport companies show that 1946 operations were at the rate of 28,314,000 miles per passenger fatality, and that 42 of the lines had no fatal accidents.

Pilot Proneness to Accident. Ben Kaufman. *Aero Digest*, Vol. 54, No. 4, April, 1947, pp. 38, 39, 148, illus. 3 references.

The application of psychological research to flying personnel as a means of reducing accidents is discussed. Figures on accidents caused by pilot error are quoted.

Plane Hits Mountain. Francis and Katherine Drake. *The Atlantic Monthly*, Vol. 179, No. 4, April, 1947, pp. 42–46.

The causes of this type of aircraft accident are discussed. It is concluded that G.C.A. and I.L.S. are of value within their limitations but are not the final answer. Steps that may be taken to advance safety are suggested.

What Is Speed Worth? *The Aeroplane*, Vol. 72, No. 1870, April 11, 1947, pp. 370, 371, illus.

Poor visibility as a cause of accidents, the use of radio aids, and the advantages of aircraft with comparatively low cruising speeds for short-haul operations as a means of increasing safety and economy are examined.

Life Companies Liberalize Rules on Overseas Flying. *Life Insurance News Data*, April 30, 1947. 1 p.

Statistics show the rising trend toward issuing new policies either without limitations or with more liberal provisions per-

On the DC-6—luxury, speed, SAFETY

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taining to flying in U.S. scheduled transports, for passengers and crew members in domestic and world-wide flights in 1946, compared with 1945, 1940, and 1935.

The Insurance Problem. Jerome Lederer. *American Helicopter*, Vol. 6, No. 5, April, 1947, pp. 28, 32.

As a step toward the estimation of helicopter insurance rates, helicopter construction, operation, and maintenance are analyzed from the standpoint of the known causes of losses in conventional airplane operation.

Landing Gear

Landing Shock and Rolling Shock on Landing Gears with Ring Spring Struts. W. Kochanowsky. (*Deutsche Versuchsanstalt für Luftfahrt, ZWB/FB/1757*, February 8, 1943.) *U.S., Army Air Forces, Translation No. F-TS-918-RE*, February, 1947. 49 pp., figs.

The vibration process and the course of forces on a coupled vibration system of two units, i.e., airplane and wheel, are investigated. The entire system vibrates also over a second undamped spring of the tire. The shock process at landing as well as at rolling over a sinusoidal ground rugosity is investigated. The influence of the size of the parts of the landing gear on stress is briefly discussed.

Cross-Wind Landing Gear. George Scheuer. *Southern Flight*, Vol. 27, No. 4, April, 1947, pp. 16, 17, 40, illus.

Description of a new castering assembly designed to eliminate ground-looping hazards involved in light-plane cross-wind landings, which has been developed by Goodyear Aircraft Corporation under special contract with the C.A.A. It allows 25° of yaw on either side of center and may be installed in conventional wheels.

New Crosswind Landing Gears of Caster Type Developed for Personal Planes. Alex Walker. *Automotive and Aviation Industries*, Vol. 96, No. 8, April 15, 1947, pp. 40–42, 68, illus. (Cf. preceding abstract.)

Aircraft Tyre Design and Development in Germany. P. H. Watson, J. W. Blinkhorn, and others. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 497, Item No. 25*. 65 pp., figs. British Information Services, New York. $1.90.

Maintenance

Dura-Repair Kits for Plywood Work. *Southern Flight*, Vol. 27, No. 4, April, 1947, p. 43, illus.

The Dura-repair kit, a compact unit for correcting flaws in Duramold structures, has been developed by the Fairchild Aircraft Division. It utilizes scarf-type joints, reinforcing rings, patches of material similar to the original, resin glue, a vacuum pump, and heat.

German Aircraft Maintenance. J. M. Jayne. *Combined Intelligence Objectives Sub-Committee, Item No. 25, 26, File No. 25-45*, July, 1945. 21 pp. British Information Services, New York. $0.70.

German Aircraft Maintenance and Overhaul Methods. J. Y. Lichtenwalner. *Combined Intelligence Objectives Sub-Committee, Item No. 25, 26, File No. 27-64*. 87 pp. British Information Services, New York. $2.35.

Mechanics Corner. R. E. Desch. *Aero Digest*, Vol. 54, No. 4, April, 1947, pp. 42, 43, 150, illus.

Information about the general principles of radiator design, installation requirements, types of cooling systems, methods of cleaning the core tubes, testing for leaks, changing the cores, and final testing of the radiator when installed in the aircraft.

Materials—General

Ceramic Materials for Machine Parts Exposed to High Heat. R. Schmid. (*Deutsche Luftfahrtforschung, ZWB/UM/Re/785*, August 31, 1944.) *U.S., Army Air Forces, Translation No. F-TS-955-RE*, March, 1947. 56 pp., illus. 3 references.

Report of a conference held at Braunschweig on March 21, 1944, including extended abstracts of papers presented at the meeting: Research and Development on Ceramic Materials, A. Schütte; Internal Stresses and Fissures at Shrinking, Solidifying, and Cooling of Porcelain, A. Scharf and F. Obenaus; Influence of Working Temperature and Material on Turbine Developments, E. Schmidt; Construction Problems in Turbines with Ceramic Blades, W. Kalisch; Connections Between Metal and Ceramics, E. Söhngen; Heat-Resistant Mixed Metal-Ceramic Materials, E. Meyer-Hartwig; Resistance Test Methods for High Temperatures, and Test Results, B. Dirksen; The Suitability of Oxide-Ceramic Materials for Gas Turbine Construction, R. Oettel; On the Heat Resistance of Silicon-Carbide Masses, G. Müller.

Development of Ceramic Materials for Use in Turbine Engines. G. H. De Witt. *Combined Intelligence Objectives Sub-Committee, Item No. 5, File No. 25-9*. 13 pp., figs. British Information Services, New York. $0.55.

Ceramic Coatings for Steel in High-Temperature Service. William N. Harrison, Dwight G. Moore, and Joseph C. Richmond. *American Society for Testing Materials, Bulletin*, No. 145, March, 1947, pp. 59–62, illus. (Cf. preceding abstract.)

Unification of Screw Threads; Conferences During June 1945 in London, Manchester, and Birmingham; Special Meeting on 6th September 1946 in London. *Institution of Mechanical Engineers, Proceedings*, Vol. 155, War Emergency Issue No. 18, 1946, pp. 145–200, figs.

Materials—Metals and Alloys

Physical Data on Certain Alloys for High Temperature Applications. A. E. White, J. W. Freeman, and F. B. Rote. *U.S., N.A.C.A., Advance Confidential Report No. 3D28 (Wartime Report No. W-80)*, April, 1943. 255 pp., figs.

The data constitute a summary of the physical properties of 120 samples of metal alloys, representing 86 different compositions that have been investigated for their suitability as turbosupercharger wheel materials. The reported data include the chemical composition, fabrication procedure, tensile-test and hardness values at room temperatures, and tensile and rupture-test characteristics at 1,200°F. Comments of contributors of the test materials concerning the workability and machinability of the alloys are included.

Some Steels for Gas Turbines. *The Aeroplane*, Vol. 72, No. 1869, April 4, 1947, pp. 340, 341, illus.

The characteristics of G.18B austenitic steel, produced by William Jessop and Sons, Ltd., for gas turbine applications, are described, together with some problems solved in connection with its development. This steel is used for turbine discs, nozzle guide vanes, and rotor blades.

Experimental Study of the Coating Formed on Nitrided-Steel Piston Rings During Operation in Nitrided-Steel Cylinders. A. R. Bobrowsky, J. Howard Kittel, and Charles P. Boegli. *U.S., N.A.C.A., Advance Confidential Report No. 4C31 (Wartime Report No. E-143)*, March, 1944. 28 pp., illus. 5 references.

Length Changes in Metals Under Torsional Overstrain. H. W. Swift. *Engineering*, Vol. 163, No. 4236, April 4, 1947, pp. 253–257, figs.

Nickel-Manganese-Chromium Steel Wire for Aircraft Control Cables. Henry C. Boynton. *Materials & Methods*, Vol. 25, No. 4, April, 1947, pp. 91–93, illus. (Cf. AER 1/47:43.)

A Rapid Method for Accurate Yield Strength Determination Without Stress-Strain Curves. L. J. Ebert, M. L. Fried, and A. R. Toole. *American Society for Testing Materials, Bulletin*, No. 145, March, 1947, pp. 50–53, figs.

By means of charts which relate yield loads and total elongations to yield strengths for test specimens of various cross-sectional areas, it is possible to determine the correct value of total elongation, as measured with an extensometer, at which to read the actual yield load from the tension machine dial. The errors involved in the method are of the same order as, or are less than, the errors involved in making the measurements.

Tensile and Compressive Stress-Strain Curves and Flat-End Column Strength for Extruded Magnesium Alloy J-1. Carl A. Rossman. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-604)*, April, 1942. 14 pp., illus. 2 references.

Heat Treatment and Aging 61S Sheet. J. A. Nock, Jr. *The Iron Age*, Vol. 159, No. 17, April 24, 1947, pp. 48–54, figs.

Consideration is given to the effects on the physical properties of this alloy of solution heat-treating temperatures, room-temperature aging, artificial-aging temperatures, interval of room-temperature aging prior to artificial aging, and reheating of heat-

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treated material. The corrosion-resistance properties of the alloy are discussed.

Sand-Cast Aluminium-Magnesium Alloys. R. T. Parker, G. M. L. Cox, and A. N. Turner. *Engineering*, Vol. 163, No. 4236, April 4, 1947, pp. 273, 274, figs.

Aluminum-base alloys containing magnesium have good mechanical properties and corrosion resistance, especially casting alloy containing 10 per cent magnesium. The specified minimum mechanical properties of test bars cast in dry sand in this alloy to specification D.T.D. 300a are ultimate tensile strength, 16 tons per sq.in., and elongation 7 per cent in 2 in., but values far in excess of these minima can be obtained. The possibility of obtaining strengths of 23 tons per sq.in., coupled with a high elongation, from a sand-cast alloy is attractive. Details are given about an investigation carried out to determine under what conditions consistently high values for the properties are realizable with the aluminum alloy containing 10 per cent magnesium.

Recovery of Aluminium Alloys from Aircraft Scrap. C. F. J. Francis-Carter, G. E. A. Bramley, and G. D. P. King. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 376, Item No. 21.* 99 pp., illus. British Information Services, New York. $2.50.

Materials—Plastics and Plywood

Fatigue of Sandwich Constructions for Aircraft; Cellular Cellulose Acetate Core Material in Shear. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1559*, December, 1946. 11 pp., illus.

Twelve control specimens were loaded statically to determine the strengths of the acetate in shear, and 23 specimens were loaded repeatedly to various percentages of the control strengths to determine the fatigue limits. Control specimens were loaded to failure in a hydraulic testing machine and maximum loads were determined. Fatigue specimens were tested in a direct-stress fatigue machine at the rate of 900 cycles per min. One specimen withstood 25,075,000 cycles of a maximum stress of 45 lbs. per sq.in. Results are tabulated and plotted on a chart showing the number of cycles to failure compared with the maximum repeated shear stress expressed in percentage of the controls.

Buckling of Stiffened, Flat, Plywood Plates in Compression. Supplement—A Single Stiffener Perpendicular to Stress; Face Grain of Plywood at 45° to Its Edges. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1553-A*, November, 1946. 22 pp., illus. (Cf. AER 4/47:58.)

An approximate formula for the critical stiffness of the stiffeners is presented, which was obtained from data on 74 tests of nine stiffened plates. It is believed that the assumptions used in developing the formula are reasonable and that the formula safely applies to plates of any practical dimensions.

Tentative Methods of Test for Determining Strength Properties of Core Material for Sandwich Construction. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1555*, December, 1946. 26 pp., illus.

Detailed instructions are set forth with respect to the scope of the tests, preparation of the specimens, loading procedure, load-deformation curves, test equipment, definitions, and calculation of results of tests for compression, tension, and shear of the core materials and of the glue lines between cores and faces.

Tentative Methods for Conducting Mechanical Tests of Sandwich Constructions. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1556*, December, 1946. 8 pp., illus.

The recommendations cover general procedures, specimens, equipment, and test methods. They establish rules for testing compression edgewise and flatwise, tension edgewise and flatwise, and bending flatwise.

Bolt-Bearing Strength of Wood and Modified Wood; Bearing Strength of Wood Members Reinforced with Plywood and Cross-Banded Compreg Under Single and Multiple Aircraft Bolts. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1523-D*, September, 1946. 49 pp., illus. (Cf. AER 2/47:57.)

This report presents the results of approximately 5,900 tests of the effects of type, thickness, and orientation of cross-banded reinforcement on the bolt-bearing strength of reinforced wood members, both in single-bolt specimens and in typical aircraft fastenings involving from two to six bolts in line. It includes also a comparison of the results of tests of multiple-bolt fastenings as obtained with fittings of three styles.

Bolt-Bearing Strength of Wood and Modified Wood; Bearing Strength of Commercial Aircraft Plywood Under Aircraft Bolts. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1523-C*, November, 1946. 43 pp., illus. (Cf. AER 2/47:57.)

Tests of plywoods and bolts manufactured according to Army-Navy Aeronautical Specifications show that the bolt-bearing stresses at the proportional limit and at the ultimate decrease with an increase in bolt diameter, and increase with an increase in thickness of plywood, within the range studied. Stresses at proportional limit bear a systematic relationship to the ultimate compressive strength; deformations in bearing vary approximately as the thickness of the plywood but bear no consistent relationship to the bolt diameter.

Rate of Development of Joint Strength by Four Resin Glues on Eight Species of Wood. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1547*, September, 1946. 11 pp., figs.

Methods of Conducting Buckling Tests of Plywood Panels in Compression. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1554*, December, 1946. 22 pp., illus.

Test methods are presented for unstiffened flat plywood panels with the direction of applied load at various angles to the face grain, and for stiffened panels with direction of applied load at 0° or 90° to the face grain. Specifications are listed for the size of specimens, direction of grain, loading procedure, load-deformation data, moisture content, and specific gravity.

Approximate Methods of Calculating the Strength of Plywood. L. J. Markwardt and A. D. Freas. *U.S., Forest Products Laboratory, Madison, Wis., Report No. R1630*, Revised, October, 1946. 5 pp., tables.

Abridged and simplified formulas and tables applicable for approximate calculations of sufficient accuracy for most structural design purposes where buckling of the plywood does not occur.

Fluid-Pressure Molding of Plywood. Bruce G. Heebink. *U.S., Forest Products Laboratory, Madison, Wis., Report No. R1624*, July, 1946. 24 pp., diagrs. 33 references.

Materials, equipment, and techniques are described, as well as the adhesives used and the apparatus for applying heat and pressure.

The Elastic Properties of Wood. *U.S., Forest Products Laboratory, Madison, Wis.*

II—Young's Moduli and Poisson's Ratios of Sitka Spruce and Their Relations to Moisture Content. J. T. Drow and R. S. McBurney. *Report No. 1528-A*, October, 1946. 36 pp., figs.

III—The Moduli of Rigidity of Sitka Spruce and Their Relations to Moisture Content. D. V. Doyle, R. S. McBurney, and J. T. Drow. *Report No. 1528-B*, September, 1946. 13 pp., figs.

IV—Young's Moduli, Moduli of Rigidity, and Poisson's Ratios of Mahogany and Khaya. D. V. Doyle and J. T. Drow. *Report No. 1528-C*, November, 1946. 14 pp., figs.

V—Young's Moduli and Poisson's Ratios of Douglas-Fir and Their Relations to Moisture Content. R. S. McBurney and J. T. Drow. *Report No. 1528-D*, November, 1946. 15 pp., figs.

VI—The Moduli of Rigidity of Douglas-Fir at About 11 Percent Moisture Content. D. V. Doyle, R. S. McBurney, and J. T. Drow. *Report No. 1528-E*, November, 1946. 12 pp., figs.

VII—Young's Moduli, Poisson's Ratios, and Moduli of Rigidity of Sweetgum at Approximately 11 Percent Moisture Content. R. S. McBurney, D. V. Doyle, and J. T. Drow. *Report No. 1528-F*, November, 1946. 15 pp., figs.

VIII—Young's Moduli, Moduli of Rigidity, and Poisson's Ratios of Yellow-Poplar. J. T. Drow and R. S. McBurney. *Report No. 1528-G*, December, 1946. 13 pp., figs.

IX—Young's Moduli, Moduli of Rigidity, and Poisson's Ratios of Yellow Birch. J. T. Drow and R. S. McBurney. *Report No. 1528-H*, November, 1946. 6 pp., tables.

Effect of Catalysts and pH on Strength of Resin-Bonded Plywood. G. M. Kline, F. W. Reinhart, R. C. Rinker, and N. J. De Lollis. *U.S., N.A.C.A., Technical Note No. 1161*, April, 1947. 39 pp., figs. 7 references. (*See* AER 2/47:59.)

Resistance to Fatigue Stressing of Wood-to-Metal Joints Glued with Several Types of Adhesives. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1545*, August, 1946. 9 pp., illus.

A Comparison of the Durability of 23 Urea Resins in Glue Joints Exposed to Nearly Saturated Air at 75°C. (167°F.). *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1355,* September, 1946. 9 pp., illus.

Tensile Strength at Elevated Temperature of Glued Joints Between Aluminum and End-Grain Balsa. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1548,* September, 1946. 11 pp., illus.

Variation in Maximum Allowable Assembly Time with Age in the Pot at Time of Spreading for Four Resin Glues. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1546,* September, 1946. 15 pp., figs.

Curing of Resorcinol-Resin Glues at Temperatures from 40° to 80°F. W. Z. Olson, H. D. Bruce, and V. R. Soper. *U.S., Forest Products Laboratory, Madison, Wis., Report No. R1629,* September, 1946. 9 pp., tables.

Effect of Thickness of Glue Line on Strength and Durability of Glued Wood Joints. *U.S., Forest Products Laboratory, Madison, Wis., Report No. R1616,* September, 1946. 26 pp., figs.

Panels were made of two-ply veneer with seven different glues in six glue-line thicknesses. Temperature, humidity, and shear tests showed that shear strength decreased with increase in thickness of the glue line, but the durability was not significantly affected by the thickness. The casein glue was adversely affected by moisture; the urea glues in general were weakened most by hot, moist condition (158°F., 20 per cent relative humidity); the phenol and resorcinol glues did not change much under the various conditions of the exposure.

Medicine

The Effect of High Altitude on Oral Tissues. Carlos Schuessler. *The Military Surgeon,* Vol. 100, No. 4, April, 1947, pp. 318–322. 23 references. Medical investigations relating to the effect of flight on teeth and related structures are reviewed and evaluated.

Formation Vertigo: Oculo-Vestibulo Disorientation in Formation Flying. Edmund P. Fowler. *The Military Surgeon,* Vol. 100, No. 4, April, 1947, pp. 330–335, figs. 4 references.

Meteorology

Over-Water Microwave-Propagation Forecasting. John R. Gerhardt and William E. Gordon. *American Meteorological Society, Bulletin,* Vol. 28, No. 3, March, 1947, pp. 126–136, figs.

The propagation of radio waves above about 30 megacycles is seriously affected by certain weather phenomena. The meteorological aspects of this effect for a particular case are considered and a forecasting technique proposed.

Radar Photographs of a Frontal Wave. Raymond Wexler. *The Journal of Meteorology,* Vol. 4, No. 2, April, 1947, pp. 69–71, fig. 2 references.

Weather Radar Research at M.I.T. Alan C. Bemis. *American Meteorological Society, Bulletin,* Vol. 28, No. 3, March, 1947, pp. 115–117. 4 references.

A Rule for Forecasting the Eccentricity and Direction of Motion of Tropical Cyclones. Yale Mintz. *American Meteorological Society, Bulletin,* Vol. 28, No. 3, March, 1947, pp. 121–125, figs. 5 references.

The rule is formulated that in regions with horizontal temperature gradients tropical cyclones are eccentric on the warm air side and move along the mean free air isotherms, keeping the warmer air to the right of the direction of motion.

Speed of Propagation of Atmospheric Waves with Changing Shape. George E. Forsythe. *The Journal of Meteorology,* Vol. 4, No. 2, April, 1947, pp. 67–69, fig. 7 references.

Tracking Storms by Forerunners of Swell. Walter H. Munk. *The Journal of Meteorology,* Vol. 4, No. 2, April, 1947, pp. 45–57, figs. 8 references.

Smoke Sources and Visibility Forecasting in Great Britain and Ireland. H. H. Lamb. *Ireland, Meteorological Service, Dublin, Technical Note No. 3 (Advance Issue),* January 14, 1944. 6 pp., fig.

Diurnal Variation of Moisture and Stability Aloft in the Vicinity of San Juan, Puerto Rico. Herbert Riehl. *American Meteorological Society, Bulletin,* Vol. 28, No. 3, March, 1947, pp. 137–143, figs. 1 reference.

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Some Remarks on the Measurement of Curvature and Vorticity. George W. Platzman. *The Journal of Meteorology*, Vol. 4, No. 2, April, 1947, pp. 58–62, figs. 6 references.

Formulas are presented for measuring the curvature of spherical curves and the vorticity of spherical motion. Properties of the polar stereographic projection are considered and applications made to the theory of constant-vorticity trajectories.

Navigation

Note on Dreisonstok's Method in Celestial Navigation. N. Wyman Storer. *Navigation*, Vol. 1, No. 5, March, 1947, pp. 98–100. 3 references.

A suggested simplification of the rules involves dividing the astronomical triangle into two right triangles by a perpendicular from the zenith to the hour circle of the object observed. One triangle, the "time" triangle, includes the assumed latitude and meridian angle. A double-entry table gives other quantities by which the other, "altitude," triangle can be solved.

Critical Tables for Correcting Observed Altitudes for Atmospheric Refraction in Polar Latitudes. Charles H. Smiley. *Navigation*, Vol. 1, No. 5, March, 1947, pp. 109, 110.

A critical table is offered for latitudes 2° to 10°, temperature 0°F., and barometric pressure 29.5 in. Special refraction corrections are suggested for tables with precomputed altitudes corrected for refraction, such as H.O. 249. These would be appropriate for each of the regions covered, one set for latitudes 0° to 35°, another for 35° to 70°, and a third for 70° to 90°.

Single Grid-Heading Flight Planning over Polar Regions. Irving I. Gringorten. *Navigation*, Vol. 1, No. 5, March, 1947, pp. 107–109, figs. 8 references.

Periscopic Sextant. *Square D Co., Kollsman Instrument Div., Release*, Recd. April 10, 1947. 2 pp., illus.

The instrument combines a special-type sextant with a periscopic optical system. It permits the navigator to make observations from within the cabin of the airplane and eliminates the astrodome. A portion of the periscope, a little more than 1 in. in diameter and $1^1/_2$ in. long is exposed through a special shock mount in the skin of the plane. The seal between the assembly and the aircraft structure is designed to withstand a differential pressure of 15 lbs. per sq.in.

Loran Supersonic Trainer Device 15-T-3. A. A. Chester. *Navigation*, Vol. 1, No. 5, March, 1947, pp. 113–115.

Description of the equipment, consisting of supersonic transmitters on a table in positions corresponding to locations of loran stations on the earth, and a supersonic receiver mounted on a Link trainer, with apparatus for simulating the signal, amplifying it, converting it to loran carrier frequency, and feeding it to the receiver. All types of problems, sector searches, homing, and others can be reproduced, the student performing the operational duties and comparing his results with actual occurrences.

Radio "Fix" Device Enables Pinpoint Avigation. Francis C. Byrnes. *Aviation*, Vol. 46, No. 4, April, 1947, pp. 52, 53, 103, 104, illus.

A system of coordinated compasses, utilizing standard ground radio signals, automatically and continuously plots the course of an aircraft, transmitting to the pilot an easy-to-follow visual picture of the craft's location. It is proposed as a means of increasing air safety during bad weather and of cutting down stacking time at destination.

Competent Navigation Equals Greater Air Safety. Harold A. Fulton. *Air-Sea Safety*, Vol. 2, No. 4, April, 1947, pp. 17–21.

It is urged that higher experience requirements for the flight navigator be established to provide greater safety for the flying public.

Impact of Supersonic Speeds on Air Navigation. William J. Catlett, Jr. *Air-Sea Safety*, Vol. 2, No. 4, April, 1947, pp. 7–16, illus. (Cf. AER 4/47:62.)

Parachutes

The Rate of Descent of Parachutes from Various Altitudes. Kenneth E. Penrod, George L. Maison, and James E. McDonald. *Journal of the Aeronautical Sciences*, Vol. 14, No. 5, May, 1947, pp. 303–310, figs. 5 references. (*See* AER 4/27:28.)

Production—General

A Survey of Production Techniques Used in the German Aircraft Industry and a Comparison with U.S. Practices of Machines, Production Labor and Plant Layout Used in the German Aircraft Industry. M. J. Meader. *Combined Intelligence Objectives Sub-Committee, Item No. 25, File No. 25-42*, July, 1945. 14 pp. British Information Services, New York. $0.55.

The Relationship of Aircraft Detail Design to Tooling and Manufacturing Costs. W. A. Davidson, P. H. Pelley, R. E. Saunders, and J. W. Rix. *Preprint, S.A.E. National Personal Aircraft Meeting*, Wichita, May 1–2, 1947. 6 pp.

Production Methods

Manufacturing Process for Fabrication of Turbine Blades Used in 109-003 BMW Jet Propulsion Engine. C. Herberger and A. Keller. *Combined Intelligence Objectives Sub-Committee, Item No. 5, File No. 30-59.* 5 pp., fig. British Information Services, New York. $0.20.

Machining Reduction Gears: Some Problems Encountered in the Generation of Bevel Wheels for the Unconventional Airscrew-Drive of the Bristol Type 167. *Aircraft Production*, Vol. 9, No. 101, March, 1947, pp. 104–107, illus.

New Replica Techniques for Evaluating Engine Wear. *Automotive and Aviation Industries*, Vol. 96, No. 8, April 15, 1947, pp. 36, 37, 78, illus.

A National Bureau of Standards process is based on the use of a plastic replica which reproduces in minute detail the protuberances and recesses of a surface, and a photoelectric means of evaluation. A process developed by the N.A.C.A. also uses a plastic replica which is viewed microscopically.

Submerged Melt Welding of Corrosion-Resistant Metals. R. J. Anderson and H. J. Roberts. *The Welding Journal*, Vol. 26, No. 4, April, 1947, pp. 338–342, illus. Physical and chemical problems and methods developed for solving them are applied also to heat-resistant and clad metals.

Ryan Welding Innovations. William P. Brotherton. *The Welding Journal*, Vol. 26, No. 4, April, 1947, pp. 323–326, illus. Welding techniques and tools developed by The Ryan Aeronautical Company.

Bristol Type 167. III—The Inner-Wing Structure: Assembly-Fixture Design: Spar Machining. *Aircraft Production*, Vol. 9, No. 102, April, 1947, pp. 127–135, illus. (Cf. AER 2/47:63.)

Photographic Layout-Reproduction. J. Johnston. *Aircraft Production*, Vol. 9, No. 102, April, 1947, pp. 123–126, illus.

Features of this method as applied to full-scale copying for template preparation and other work at a plant of Airspeed, Ltd. The camera, which is of British design, and accessory equipment are described.

Temperature Charts for Induction and Constant-Temperature Heating. M. P. Heisler. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 3, April, 1947, pp. 227–236, figs. 10 references.

Charts for determining complete temperature histories in spheres, cylinders, and plates, which also give temperature distributions throughout the body rather than only at the surface and center.

Industrial Practice for Spot Welding Light Alloys. British Welding Research Assn., L.R.4 Committee on Spot Welding Procedure for Light Alloys. *Sheet Metal Industries*, Vol. 24, No. 240, April, 1947, pp. 824–828, 830, figs.

Consideration is given to the different types of machines used for the purpose, machine settings, and mechanical maintenance. Methods of surface preparation, assembly, inspection, and control are described. Solutions and pastes for surface preparation are listed.

Spot-Welding of Assemblies. Floyd Matthews. *Aero Digest*, Vol. 54, No. 4, April, 1947, p. 82, illus.

The primary structures of the Stratocruisers and Stratofreighters, in production by the Boeing Aircraft Company, are being spot-welded. The percentage of spot welding has been increased and riveting has been kept to a minimum. Improved appearance, aerodynamic efficiency, and structural integrity have resulted.

Production Tools and Equipment

Special-Purpose Machine Tools for Cavity-Profiling and Bolt-Grinding on de Havilland Gas-Turbine Diffuser Casings. *Air-*

craft Production, Vol. 9, No. 101, March, 1947, pp. 83–87, illus.

Profiling Impeller Vanes. *Aircraft Production*, Vol. 9, No. 102, April, 1947, pp. 153–156, illus. Details about a special-purpose profile-copying machine used for shaping the impeller vanes of de Havilland gas turbines.

German Airframe Tooling and Methods, Messerschmitt Works. Richard G. Bowen. *Combined Intelligence Objectives Sub-Committee, Item No. 5, 25, 27, File No. 28-25.* 28 pp., illus. British Information Services, New York. $0.90.

Zinc-Alloy Press Tools. I, II. J. W. Sladden and H. S. Walker. *Aircraft Production*, Vol. 9, Nos. 101, 102, March, April, 1947; pp. 115–119; pp. 145–149; illus.

Propellers

Factors Affecting the Design of Quiet Propellers. Arthur A. Regier and Harvey H. Hubbard. *Paper presented at I.A.S. Fourth Annual Personal Aircraft Meeting*, Detroit, May 26–27, 1947. (For abstract see "I.A.S. Briefs" on page 24 of this issue, June, 1947.)

A Flight Investigation of the Thermal Performance of an Air-Heated Propeller. John F. Darsow and James Selna. *U.S., N.A.C.A., Technical Note No. 1178*, April, 1947. 23 pp., illus. 4 references.

The thermal performance of an air-heated propeller was evaluated by observations of the ice-prevention properties of the propeller during flight in natural-icing conditions and by the collection of thermal data on the propeller during flight in clear air and in clouds at temperatures above freezing. The test propeller was equipped with hollow steel blades of a standard design which were altered to permit heated air to enter the blade cavities at the propeller hub and to leave at the blade tips. The observations indicated that little or no protection to the leading-edge region of the blades would result during severe icing conditions. Under the light icing conditions encountered, ice accretions formed on the leading edges in the region of blade stations 30 to 40. More heat energy was discharged in the airflow than was dissipated through the blade surfaces. Greater heat flow through the leading-edge region is needed.

Propeller Electric De-Icing System for Wide-Range Operating Conditions (United Aircraft Corp., Hamilton Standard Propellers Div.) *Aviation*, Vol. 46, No. 4, April, 1947, p. 65, figs. (Cf. AER 3/47:81.)

Soundproofing the Prop. Clintie Kenney. *Flying*, Vol. 40, No. 5, May, 1947, pp. 52, 53, 94, 96, illus. A review of N.A.C.A. research that has achieved good results by the use of fan-type, multibladed propellers.

Notes on Propellers with Swept Back Tips. Frank Lawton. *American Helicopter*, Vol. 6, No. 5, April, 1947, pp. 29, 30, fig.

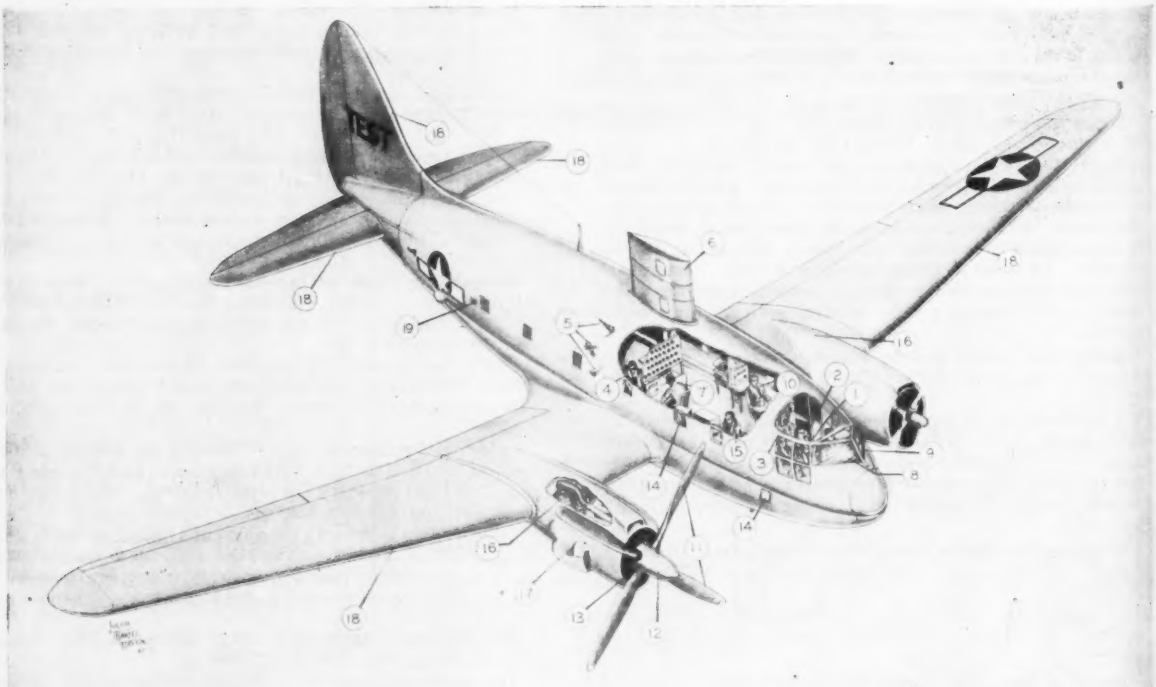
Self-Adjusting Propeller Employs Natural Forces to Effect Pitch Changes. Paul F. Hackethal. *Machine Design*, Vol. 19, No. 4, April, 1947, pp. 141–144, illus.

The Aeromatic propeller utilizes the natural forces acting on the blade and on a counterweight to accomplish automatically the desired change in pitch for varying conditions of flight. The automatic operation represents a continuous state of balance between the pitch-changing tendencies of (a) aerodynamic force components of thrust and torque acting on the blade, (b) centrifugal force acting on the blade, and (c) counterweight force, to maintain a virtually constant engine speed at a fixed throttle setting and altitude, the pitch changes being stepless.

Evolution of an Automatic Variable Pitch Propeller. John D. Waugh. *Preprint, S.A.E. National Personal Aircraft Meeting*, Wichita, May 1–2, 1947. 28 pp., illus.

The theoretic conception, design philosophy, and mechanical progress in the development of the Aeromatic propeller are reviewed.

World's Smallest Black Light Is Big New Aid to Airplane Safety. *Black Light Beacon*, Vol. 3, No. 5, April, 1947, pp. 17, 19, illus.



Cutaway drawing of the special Curtiss C-46 Commando icing research airplane of the National Advisory Committee for Aeronautics. This plane and its crew of eight engineers and technicians is now engaged in bad weather flights throughout the Northwest United States. Object of these flights is to obtain scientific data on the icing of aircraft in flight and on the effectiveness of various methods for its prevention and removal.

The Borescope incorporates a high-intensity quartz mercury lamp element, for inspection of the interior of hollow-steel propeller blades. Defects are revealed in fluorescent, greenish-white lines.

Better Propellers for Light Pocketbooks. John F. Haines. *Preprint, S.A.E. National Personal Aircraft Meeting*, Wichita, May 1–2, 1947. 10 pp., figs. (Cf. AER 3/47:79.)

Radio

Long-Range Radio Navigation Aids. I—Cathode Ray Direction Finding and the Automatic Radio Compass. *The Aeroplane*, Vol. 72, No. 1867, March 21, 1947, pp. 277, 280–282, illus.

Following a discussion of the frequency bands desirable for short- and long-range navigation, consideration is given to the operating principles of cathode-ray direction-finding equipment for ground stations and to the automatic radio compass for aircraft.

Radio Equipment in the Solents. Basil R. Clarke. *Flight*, Vol. 51, No. 1998, April 10, 1947, pp. 320, 321, illus. A brief technical description of the radio installation of the Short Solent flying boats.

New Philco Direct-Reading Loran Receiver Provides Double Counters, Automatic Frequency Control in Compact 35-Pound Single-Unit Equipment. *Philco Corp., Release*, Recd. May 7, 1947. 2 pp.

The receiver measures the time difference between the received pulses from master and slave Loran transmitter stations, without the need for reading markings on the screen of the indicator oscilloscope. There are four channels in the 1,700–2,000 kc. band, and two channels in the 180–220 kc. band. Three pulse repetition rates—20, 25, and 33 1/3, permit reception of eight shore station pairs on each rate. Overwater range is 1,400 nautical miles at night and approximately 750 miles during the day.

German Research and Development in the Radio Field, Lyons Area. J. Z. Menard. *Combined Intelligence Objectives Sub-Committee, Item No. 1, File No. 11-7.* 31 pp. British Information Services, New York. $1.00.

Rotating Wing Aircraft

Charts for Determining the Effect of Rotor-Tip Speed, Blade Solidity and Rotor-Disc Loading on the Range of a Helicopter. J. P. Chawla. *Cornell Aeronautical Laboratory.* (For abstract see "I.A.S. Briefs" on page 26 of this issue, June, 1947.)

Bending of Rotor Blade in the Plane of Rotation. Shao Wen Yuan. *Journal of the Aeronautical Sciences*, Vol. 14, No. 5, May, 1947, pp. 285–293, figs. 2 references.

A theoretic analysis, with consideration of the elasticity of the blade. The analysis includes the bending of a blade with variable mass distribution along the span. The results lead to matrix equations that are convenient for arithmetic calculation. The application of the analysis is illustrated by numerical calculations. The results found in the case of a typical rotor blade show that the maximum deflection in the plane of rotation is about one-tenth of that in the flapping plane and that the maximum bending moment in the plane of rotation is about one-fourth of that in the flapping plane. When a blade with variable section is compared with one with an equivalent constant blade section, the bending moment for the variable section is found to be appreciably greater than that for the equivalent constant section in the region of the inner half-span.

Stability and Control Characteristics of a Simplified Helicopter. Charles M. Seibel. *Preprint, S.A.E. National Personal Aircraft Meeting*, Wichita, May 1–2, 1947. 14 pp., figs. 4 references.

A simplified longitudinal and lateral control system is suggested in place of cyclic-pitch control. It is based on the premise that there is little difference whether the lift vector or the center of gravity is moved to effect the control. A small flying model helicopter was constructed, having a fuselage built in two parts. One portion of the fuselage was spring loaded forward and restrained by a control cord that traveled over pulleys to a control stick, the motions of which cause relative motions between the two portions of the fuselage. Stability calculations and mathematical analyses confirmed the results of experiments with the model, showing that the configuration will provide satisfactory control and stability characteristics in hovering flight. It will lead to a simpler design and reduction in initial cost and in maintenance.

Practical Engineering of Rotary Wing Aircraft. IX. Harris S. Campbell. *Aviation*, Vol. 46, No. 4, April, 1947, pp. 62, 63, 99, 103, figs. (Cf. AER 4/47:66.)

In designing rotor hub structures, special consideration must be given to certain parts that require more than merely adequate ultimate strength. The structure must be sufficiently rigid to assure proper functioning and to prevent undue wear of moving parts which might cause subsequent failure. In designing linkages for blade control, care should be taken to arrange that the movement of one control does not adversely affect another control. Basic conditions underlying rotor hub design are discussed and illustrations of typical design problems are presented.

Jet Power Applied to Helicopters. Jerome Friedenberg. *American Helicopter*, Vol. 6, No. 5, April, 1947, pp. 14, 15, 39–43, figs.

Various methods of applying jet power to helicopters are described and the difficulties encountered are pointed out. An attempt is made to prove that the ram-jet application is by far the most logical method of propulsion, both technically and economically.

Helicopter Design. J. A. J. Bennett. *Flight*, Vol. 51, No. 1997, April 3, 1947, pp. 291, 292, figs. (Extended abstract of a paper: Limitations in Helicopter Design.)

A discussion of the problems of torque, vibration, and stability. Consideration is given to both hinged and rigidly mounted blades, the single-rotor torque problem, power loading and pitch limitations, limiting translational speed, and dynamic stability.

New deLackner Helicopter Designed for Low Cost Production. *Automotive and Aviation Industries*, Vol. 96, No. 7, April 1, 1947, p. 33, illus.

Brief data on the prototype of a twin-rotor, two-place helicopter powered by a 125-hp. Lycoming engine. Rotor diameter is 24 ft.; maximum forward speed, 100 m.p.h.; and gross weight, 1,600 lbs.

New Brantly 2-Place 'Copter. *Aviation News*, Vol. 7, No. 15, April 14, 1947, p. 11, illus.

Brief description of a helicopter, designed and built by Newby O. Brantly, featuring standard aircraft wheel control and two counterrotating rotors driven through a free-wheeling unit.

French-Built Helicopters. Maurice Lamé. *American Helicopter*, Vol. 6, No. 5, April, 1947, pp. 6, 7, 43, illus. A review of early and current helicopter developments in France.

Hafner-Bristol Type 171. M. Berry. *American Helicopter*, Vol. 6, No. 5, April, 1947, pp. 17, 18, illus.

Description of a British experimental helicopter designed for air taxi service and providing space for four persons. It has a 47-ft. single main rotor, a torque tail rotor, and is powered by a 450-hp. Wasp Junior engine. Range is 200 miles at about 100 m.p.h. normal cruising speed.

Contributions of Dr. George de Bothezat to Scientific Literature. *American Helicopter*, Vol. 6, No. 5, April, 1947, pp. 24, 48. A list of 26 published and five unpublished references, from 1911 to 1936.

Flying the Bell 47 Helicopter. Walter Storck and John R. Hoyt. *Air Trails and Science Frontiers*, Vol. 28, No. 7, May, 1947, pp. 46, 109, 110, illus.

Seaplanes and Flying Boats

Variation of Hydrodynamic Impact Loads with Flight-Path Angle for a Prismatic Float at 0° and −3° Trim and with a 22 1/2° Angle of Dead Rise. Sidney A. Batterson. *U.S., N.A.C.A., Technical Note No. 1166*, April, 1947. 11 pp., figs. 7 references.

Tests were made on a prismatic float model to determine the relationship between the vertical landing acceleration and flight-path angle for seaplanes landing in smooth water. The tests were made at both high and low forward speeds. The model had a gross weight of 1,100 lbs. Over the test range of flight-path angle, the maximum vertical landing acceleration closely approximated an exponential line for 0° trim. The runs made at −3° trim showed—with only a slight variation resulting from bow effects—that, as the flight-path angle increased, greater increases in load resulted under conditions in which the sum of the trim and flight-path angle was positive than under conditions in which this sum was negative. With the model set at −3° trim the minimum depth of immersion at the instant of maximum acceleration occurred at a flight-path angle in the region between 3° and 4°. Greater depths were recorded which were especially

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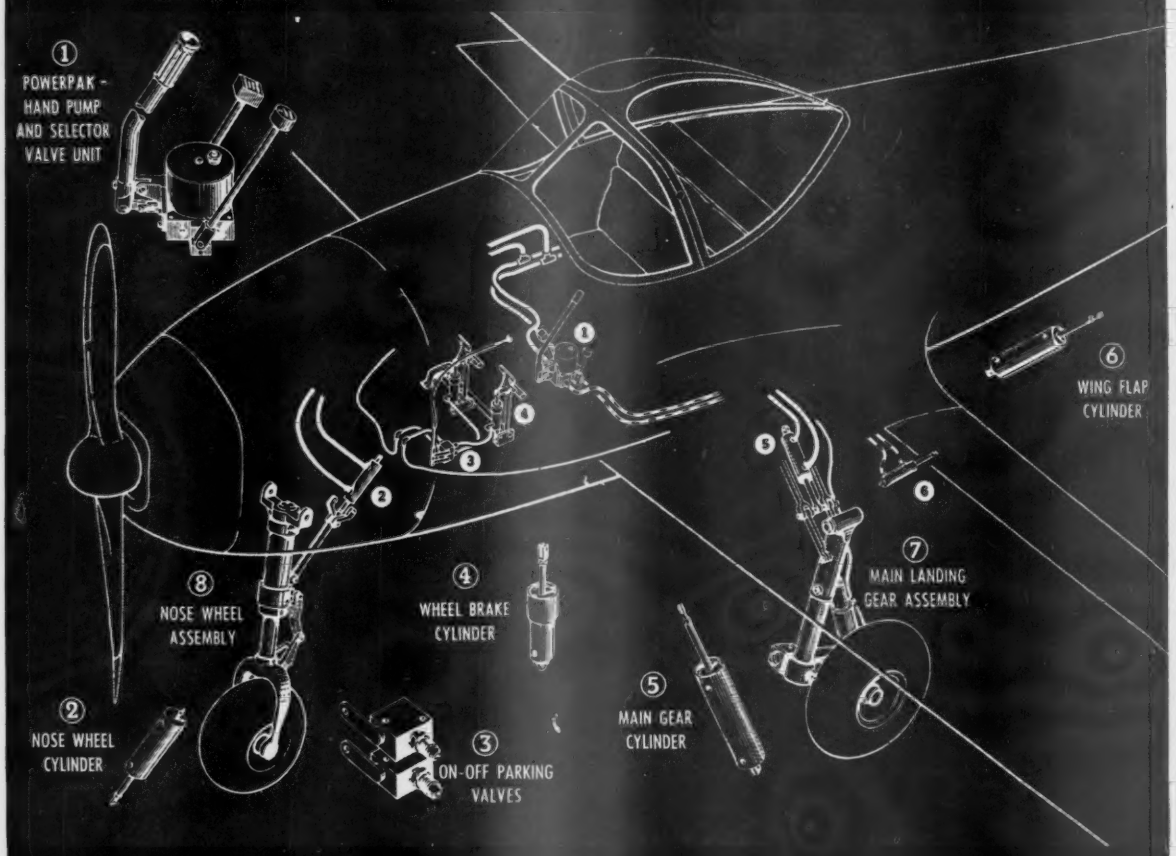
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noticeable at smaller flight-path angles. Observations based on the results of this test indicated possible hazards accompanying low-attitude, high-speed landings.

Static Stability Analysis for Flying Boats and Seaplanes. IV. Ernest G. Stout. *Aviation*, Vol. 46, No. 4, April, 1947, pp. 59–61, figs. (Cf. AER 4/47:66.)

Referring to the characteristics of an exemplary Class VP flying boat already set forth, the calculations and procedures necessary to design auxiliary floats that will meet the requirements of a previously developed equation are described.

Stress Analysis and Structures

Inelastic Column Theory. F. R. Shanley. *Journal of the Aeronautical Sciences*, Vol. 14, No. 5, May, 1947, pp. 261–268, figs. 6 references. (*See* AER 3/47:39.)

Design Criteria for Long Curved Panels of Sandwich Construction in Axial Compression. E. W. Kuenzi. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1558*, December, 1946. 36 pp., illus.

The axial buckling strength of a well-made, long, curved plate of sandwich material may be computed by adding the critical stress of a complete cylinder, of which the plate may be considered a part, to the critical stress of a flat plate having the same dimensions as the curved plate. The stress at which crimping of the entire sandwich will occur is equal to or greater than the computed critical stress, provided there are no structural defects. The analysis presented includes methods of calculating the critical stresses when the facings are stressed beyond the proportional limit.

On the So-Called Principle of Least Work Method. M. Z. Krzywoblocki. *The Franklin Institute, Journal*, Vol. 243, No. 3, March, 1947, pp. 187–204. 15 references.

A method to overcome certain defects in the Castigliano method of calculating stress in thin-walled structures assumes a minimum strain energy and presents the total strain energy as a function of the redundant generalized forces or unknown coefficients. This is followed by a process of expressing in analytic form the stationary value of the total strain energy for small variations in the redundant forces, equating to zero the first partial derivative of the strain energy with respect to each of the redundant forces. The last equation gives the value of the redundant forces or of the unknown coefficients.

The Distribution of Loads on Rivets Connecting a Plate to a Beam Under Transverse Loads. F. Vogt. (*Gt. Brit., Royal Aircraft Establishment, Report No. S.M.E. 3301*, October, 1944.) *U.S., N.A.C.A., Technical Memorandum No. 1134*, April, 1947. 26 pp., figs. 1 reference.

Two methods of solution are given which are applicable to loads up to the limit of proportionality: (1) the rivets are treated as discrete members, and (2) they are replaced by a continuous system of jointing. A method of solution is also given which is applicable when nonlinear deformations occur in the rivets and in the plate but not in the beam. Numerical examples illustrate the methods of analysis. The examples show that the loads carried by the rivets and the plate are less than the values given by classical theory, which disregards the slip of the rivets, even below the limit of proportionality. This difference is considerably accentuated when nonlinear deformations occur in the structure and the beam then carries the greater portion of the bending moment. If the material of the beam has a higher proportional limit and a higher ultimate strength than the material of the plate, there is thus a transfer of load from weaker to stronger material, and this is to the advantage of the structure.

The Load Distribution in Bolted or Riveted Joints in Light-Alloy Structures. F. Vogt. (*Gt. Brit., Royal Aircraft Establishment, Report No. S.M.E. 3300*, October, 1944.) *U.S., N.A.C.A., Technical Memorandum No. 1135*, April, 1947. 50 pp., figs. 13 references.

A theoretic discussion applicable for loads below and above the limit of proportionality. The theory is developed for double and single shear joints. The methods given are illustrated by numerical examples and the values assumed for the bolt (or rivet) stiffnesses are based partly on theory and partly on known experimental values. The load distribution does not vary greatly with the bolt (or rivet) stiffnesses and for design purposes it is usually sufficient to know their order of magnitude. The theory may also be directly used for spot-welded structures and, with small modifications, for seam-welded structures. The computations involved are simple and reasonably rapid for most practical problems. A summary of earlier theoretic and experimental investigations is included.

The Effective Stiffness of a Stiffener Attached to a Flat Plywood Plate. C. B. Smith, T. B. Heebink, and C. B. Norris. *U.S., Forest Products Laboratory, Madison, Wis., Report No. 1557*, September, 1946. 41 pp., figs.

Data obtained from 107 tests of 17 plates with stiffeners of varying depths supply reasonable confirmation of the mathematical analysis. The formulas developed make it possible to locate the position of the neutral surface and to compute the stiffness added to the plate by the stiffener glued to one face of the plywood.

The Center of Shear and the Center of Twist. A. Weinstein. *Quarterly of Applied Mathematics*, Vol. 5, No. 1, April, 1947, pp. 97–99. 5 references.

In two recent papers W. R. Osgood and J. N. Goodier reconsider the much-discussed question of the center of shear and center of twist, the former writer pointing out the disagreement in the literature as to the location of the center of shear. An important paper by P. Cicala, together with a paper of Trefftz, forms the basis of this further discussion, in which it is shown that a definition can be given which is based on Saint-Venant's formulas and leads to an explicit proof of the coincidence of both centers.

Punch-Card Machine Methods Applied to the Solution of the Torsion Problem. Stefan Bergman. *Quarterly of Applied Mathematics*, Vol. 5, No. 1, April, 1947, pp. 69–81, figs. 11 references.

The writer previously developed certain theoretic methods (the "method of orthogonal functions" and the "method of particular solutions") for solving boundary-value problems. This paper illustrates the application of orthogonal functions to the solution of Laplace's equation $(\partial^2\phi/\partial x^2) + (\partial^2\phi/\partial^2 y^2) = 0$ through the use of punch-card machines. It is concerned with a method of solving the torsion problem for a bar of uniform cross section.

On Bending of Elastic Plates. Eric Reissner. *Quarterly of Applied Mathematics*, Vol. 5, No. 1, April, 1947, pp. 55–68. 13 references.

The main purpose of the paper is to present the writer's earlier derivations in simpler and more general form. Although previously an isotropic homogeneous material was assumed, plates of homogeneous or nonhomogeneous construction are now considered with elastic properties which, in the direction perpendicular to the plane of the plate, are different from the elastic properties in directions parallel to the plane of the plate.

Fatigue Tests on Some Spot-Welded Joints in Aluminum Alloy Sheet Materials. H. J. Grover and L. R. Jackson. *The Welding Journal*, Vol. 26, No. 4, April, 1947, pp. 215-s–232-s, illus. 10 references.

The following simple structural elements were tested at the Battelle Memorial Institute: spot-welded stiffened panels, sheets with spot-welded attachments, and spot-welded lap joints. Among the variables examined were sheet thickness, spot-weld spacing and, to a lesser extent, sheet material and welding procedure. The results of the tests are summarized.

An Introduction to the Mathematical Theory of Plasticity. W. Prager. *Journal of Applied Physics*, Vol. 18, No. 4, April, 1947, pp. 375–383, fig. 24 references.

The principal theories of plasticity are set forth without going into an explanation of the general stress-strain relations used in those theories. The mechanical behavior of plastic materials under shear only is discussed. Theories of plastic deformation (Hencky, Nadai) and of plastic flow (Saint-Venant-Lévy-Mises, Prandtl-Reuss, Prager) are illustrated by examples of a prismatic bar under torsion.

The Motion of a Conical Coil Spring. I. Epstein. *Journal of Applied Physics*, Vol. 18, No. 4, April, 1947, pp. 368–374, figs.

The elongations and natural frequencies of conically-shaped coil springs are derived theoretically for several dynamic boundary conditions. Frequencies are verified experimentally on nickel and piano wire springs, attesting the reliability of the computations.

Dornier Structural Strength Test Equipment and Methods. A. W. Hotson. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 66, Item No. 25.* 16 pp., illus. British Information Services, New York. $0.55. (*See* AER 5/47:57.)

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De Havilland Vibration Equipment; Leaflets 1–8. *De Havilland Propellers Ltd.*, Hatfield, Herts, England, 1947.

Technical descriptions and applications of moving-coil vibrators; driving amplifiers for vibration and fatigue testing; piezo-crystal pickups; six-channel signal amplifiers; twelve-channel recording cameras; resistance strain gages; and six- or twelve-circuit steady-stress measuring bridges.

Improved Static Testing Helped Prove DC-6. Warren W. Bradley. *Aviation*, Vol. 46, No. 4, April, 1947, pp. 49–51, illus.

Strength-gaging methods applied to one of the first DC-6 air liners nearing completion yielded important data with little interruption in its production. It was subjected to five critical combinations of positive flight loads and one negative load condition. These loads were carried to the maximum values that the plane was expected to encounter under the most adverse flying conditions. The fuselage was simultaneously subjected to internal air pressure.

Wind Tunnels and Laboratories

Shock-Wave Oscillations in Wind Tunnels. Hans-Wolfgang Liepmann and Harry Ashkenas. *Journal of the Aeronautical Sciences*, Vol. 14, No. 5, May, 1947, pp. 295–302, illus.

A choking device placed downstream of the model in a 2- by 20-in. transonic wind tunnel consists of a flexible airfoil formed of two pieces of thin spring steel, hinged at both ends, and a rotating centerpiece. The leading-edge hinge pin passes through the tunnel walls and is fastened securely to them, while the trailing-edge pin is allowed to slip between the tunnel walls. As the centerpiece is rotated, the maximum thickness of the choke is varied, changing the throat area of the tunnel and, hence, the speed in the test section. Using this device, the Mach Number in the test section can be varied continuously from 0.700 to 0.905, and values of the Mach Number may be reproduced with an accuracy of 0.5 per cent. By creating a supersonic region (through use of the choke) at the exit of the test section, the disturbances from the diffuser are not allowed to travel upstream. The results show that observed buffeting phenomena in transonic flight are not connected with the hitherto observed shock oscillations in wind tunnels.

Effect of the Tunnel-Wall Boundary Layer on Test Results of a Wing Protruding from a Tunnel Wall. Robert A. Mendelsohn and Josephine F. Polhamus. *U.S., N.A.C.A., Technical Note No. 1244*, April, 1947. 22 pp., figs. 3 references.

Tests of a 2-ft.-chord NACA 65_1-012 airfoil model in the $2^1/_2$-ft. by 6-ft. test section of the Langley stability tunnel show that a small loss in average load may be expected (less than 1 per cent of load at center). At stations close to the wall, the local load may be as much as 10 per cent lower than that at the center of the tunnel, and large changes in the tunnel-wall boundary-layer thickness produce small changes in load. At low angles of attack a tunnel-wall boundary layer has little effect on the pitching moment. At high angles of attack the average pitching moment for the wing may be different from the value at the center of the tunnel because of nonuniform stall.

Supersonic Wind Tunnel. *University of Michigan, Aeronautical Research Center, Release*, April 16, 1947. 2 pp., figs.

The wind tunnel, estimated to have a speed range of 1,000–3,500 m.p.h., was constructed by the University and the A.A.F. The tunnel operates on an intermittent principle. A surplus barrage balloon forms the storage bag from which air is released into the test section. A vacuum to exhaust the air from the bag is created by evacuating a set of nine tanks which provide 13,000 cu.ft. of space. The airflow lasts from 13 to 15 sec. About 15 min. are required to evacuate the air from the tanks. The test section is 8 in. wide and 13 in. deep, and can take models up to 12 in. in length.

Investigation of Flow in Liquids by Use of Birefringent Colloidal Solutions of Vanadium Pentoxide. Philip Ullyott. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 3, April, 1947, pp. 245–249, fig., Discussion, pp. 249–251. 23 references.

A short account of the basic processes underlying flow birefringence is given, with a survey of previous work. It is concluded that the properties of the birefringent aqueous sols of vanadium pentoxide fit it for use in experiments concerned with flow, either turbulent or laminar, or with demarcation of regions of shear in liquids.

Investigation of the Behavior of Parallel Two-Dimensional Air Jets. Stanley Corrsin. *U.S., N.A.C.A., Advance Confidential Report No. 4H24 (Wartime Report No. W-90)*, November, 1944. 36 pp., illus. 10 references.

Jet-Boundary Corrections for Reflection-Plane Models in Rectangular Wind Tunnels. Robert S. Swanson and Thomas A. Toll. *U.S., N.A.C.A., Advance Restricted Report No. 3E22 (Wartime Report No. L-458)*, May, 1943. 76 pp., figs. 9 references.

New Rubber-Testing Cold Room. *Aero Digest*, Vol. 54, No. 4, April, 1947, p. 78, illus.

Construction and operation of a cold room, installed at the B. F. Goodrich plant, for testing natural and synthetic rubbers and products containing these materials.

Members Elected

(*Continued from page 14*)

Mitchell, Jesse Lafayette, B.S. in Ae.E.; Aero. Engineer P-1, N.A.C.A.

Moore, Richard Chandler, B.S.; Airport Engineer, New York State Bureau of Aviation.

Morris, Harrison William, B.Ae.E.; Jr. Draftsman, Great Lakes Steel Corp.

Podolny, William H., B.S.

Polski, James Robert, B.S. in Ae.E.; Layout Draftsman, Chance Vought Aircraft Div., United Aircraft Corp.

Radey, Kendrick, B.S. in Ae.E.; Flutter Analyst—Mathematician, Douglas Aircraft Co., Inc. (El Segundo).

Sipe, Charles Robert, B.S. in Ae.E.; Flight Test Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Snyder, Melvin H., Jr., B.Sc.; Instructor, University of Wichita.

Thompson, Wm. D., Jr., B.S. in Ae.E.; Engineering Test Pilot, Cessna Aircraft Co.

Van Dyke, Burton, B.Ae.E.; Student Pilot, Falls City Flying Service.

Walsh, Joseph Giovannetti, B.Ae.E.

Whittaker, James Robert, B.Ae.E.; Student, Catholic Univ.

Zuch, Herman Franklin, Jr., B.S. in Ae.E.; Engineering Draftsman, The Glenn L. Martin Co.

Necrology

Joseph S. Pecker

Joseph S. Pecker, former president of the Machine Tool and Designing Company, of Philadelphia, and a consulting engineer, died on May 6 in New York. Mr. Pecker, a Member of the Institute, had retired in 1945 and was residing in Beverly Hills, Calif.

A pioneer in the development of rotary wing aircraft, Mr. Pecker was presented the National Association of Manufacturers' modern pioneer award in 1940 for his achievements in perfecting the autogiro. He was one of two engineers responsible for the 40,000 miniature automobiles and trucks in the General Motors' "Futurama" at the New York World's Fair.

During World War II, Mr. Pecker was Chairman of the Board of Rotawings, Inc., engaged in helicopter development.

Why STURDY MONEL TUBING *is ready to Solve Your Problems*

(Above) Monel Tubing fabricated by Bundy, as used in the rocker box tube assemblies.

(Above) Showing the Monel (Bundy) Tubing used in the primer tube assembly in Wright Aircraft engines. These tubes are among the many Inco Nickel Alloy products now standard with leading aircraft companies.

Easier-forming Monel* tubing offers extra strength plus ability to withstand vibration-fatigue, corrosion and high temperatures

NOTICE how those tubes are formed. Ease of forming is an important reason why aircraft engineers are specifying Monel tubing for so many applications.

These men find Monel tubing considerably more adaptable to forming than tubing of other commonly-used, high-strength materials.

Monel offers *extra* strength, too. For example, one large aircraft manufacturer called for .020" wall tubing for working pressures up to 3,000 psi. In addition, they insisted upon a safety factor of 4 to 1. This meant an actual bursting strength of 12,000 psi.

Monel tubing more than measured up. It easily took the required 12,000 psi. . . . not bursting until 13,750 psi. was reached.

Withstands extreme vibration

In tests involving vibration and pulsation, Monel tubing also more than met requirements. Pressures ranging from 0 to 3,000 psi. at the rate of 30 pulsations per minute produced no leaks in Monel tubes or fittings.

These are some of the reasons why many different shapes, sizes, and types of Nickel Alloy tubing . . . including seamless, Bundy, and welded . . . are now standard with numerous important companies.

Today, tough, corrosion-resistant, heat-resistant INCO Nickel Alloys are establishing their superiority for scores of uses in the aircraft industry.

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Primer tubing	Ignition harness tubing
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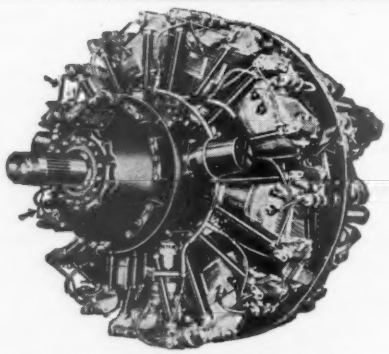

2500-hp. Wright Cyclone aircraft engine. This engine employs Monel tubing to inject fuel into cylinders and for the drain valve which eliminates condensed atmospheric moisture from the induction chamber each time engine finishes a flight. Photo courtesy of Wright Aeronautical Corporation, Woodridge, N. J.

NICKEL (INCO TRADE MARK) ALLOYS

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Books

Operation Lifeline. James Lee. Photographs by Joe Rosenthal, Supplemented by Official U.S. Navy Photographs. Chicago, Ziff-Davis Publishing Co., 1947. 171 pp., illus. $5.00.

The only deficiency in this magnificent record of the wartime operations of the Naval Air Transport Service is its somewhat unbalanced coverage. The first impression given after leafing through its pages is that NATS was basically a Pacific Theater operation. On more careful reading, some mention will be found in the text of transcontinental and Atlantic services, but readers will look in vain for a pictorial record or adequate coverage of the work at Olathe or at Patuxent River. There are scenes aplenty at Honolulu, Saipan, Manila, and Tokyo, but what about Stephenville? Bermuda? Terciera? Port Lyautey? and Prestwick and Orly? Admittedly, such ports of call are less romantic but certainly they have a place in a book that purports to be "the history and development of the Naval Air Transport Service." (Lest undue bias be charged in the above criticism, it may be noted that this reviewer served with NATS *Pacific*.)

The book is bound to induce nostalgic twinges in anyone who served with NATS. Some of the scenes are as familiar as one's own backyard—some of the markings on airplane noses as familiar as one's own telephone number. For example, old 39147 getting her rudder changed by a stripped-to-the-waist maintenance crew (page 152) is not only splendid photography but it carries the authentic, unposed feeling of the day-to-day, behind-the-scenes work that went on to maintain "Operation Lifeline" throughout the war.

Mr. Lee has evidently talked to a lot of the right people on his NATS tour and, as a result, his text, although a bit thin in spots, gives an adequate and colorful picture of NATS' operations. Mr. Rosenthal's photography, and the treatment given to his pictures by the publisher, are beyond reproach. S.P.J.

Introduction to Aeronautics. C. F. Toms. London, Charles Griffin & Co., Ltd., 1947. 404 pp., illus., diagrs. 40s.

Intended for the designer, draftsman, aircraft technician, and the student, this is a clear introduction to the principles underlying the calculations required in the design of aircraft.

All of the books reviewed and listed are in the I.A.S. Library and may be borrowed without charge, except for certain reference books. Application for loans should be made to The Paul Kollsman Lending Library, 2 East 64th Street, New York 21, N.Y.

Following an exposition of basic concepts, the reciprocating power unit is taken up, including geometric and aerodynamic characteristics of propellers, power and fuel consumption curves, exhaust efflux propulsion, and the drag of power units. The succeeding chapters deal with drag, performance estimation, flaps, take-off and landing, control and stability, wind-tunnel and flight testing, flight maneuvers, and load and pressure distribution. The final chapter deals with rotating wing aircraft. The last fourth of the book consists of appendixes presenting formulas to accompany the sections of the various chapters, and bibliographies. This is a well-arranged and carefully executed book. The author is a design engineer with the Bristol Aeroplane Company.

Principles of High Speed Flight. H. M. Conway, Jr. Atlanta, Ga., Box 1331, Southeastern Research Institute, Inc., 1947. 137 pp., diagrs. Mimeographed. $2.50.

The author's aim is to outline the important known principles of high-speed flight, without oversimplifying or presenting the theory in too much detail. Compressible fluid mechanics; transonic aerodynamics; supersonic aerodynamics; turboprop, turbojet, and ram-jet systems; and rocket power plants are the subjects of the first seven chapters. In a last chapter on development problems and trends, the discussion takes up selection of power plants, low-speed flight, structures, and physiological problems. The bibliographies at the ends of chapters include altogether 327 references to research papers in English. The appendix includes tables of properties of the N.A.C.A. standard atmosphere, properties of air at subsonic speeds, properties of air at supersonic speeds, and conditions before and after shock. The author was formerly assistant to the director of research of the National Advisory Committee for Aeronautics. The book can be recommended as an excellent presentation.

Tropical and Equatorial Meteorology. Maurice A. Garbell. New York, Pitman Publishing Corp., 1947. 237 pp., illus., diagrs., $12.

As Dr. Garbell observes, interest in the correlation of the existing knowledge of weather phenomena in the regions between the thirtieth parallels of the Northern and Southern Hemispheres is of fairly recent date. It so happens that the curve of interest closely follows the development of aviation, with a sharp increase shown at the time ocean flying was first begun and continuing through the accelerated development of air transport during the war and of the present world air routes. It is significant that this is the first book to bring the results of research in this field into authoritative and convenient reference form suitable for use by meteorologists, climatologists, navigation personnel, and students. In the first part, fundamental concepts are reviewed and supplemented by the additional information required for their application to low-latitude weather. In the second part, this fundamental knowledge is applied to the analysis of typical weather in the five large tropical weather spaces of the earth. Mathematical treatment is kept to a minimum. Working models, charts, maps, and photographs illustrate the text. The bibliography includes 238 references and there is a detailed index of subjects and geographic names.

German Research in World War II, an Analysis of the Conduct of Research. Leslie E. Simon. New York, John Wiley & Sons, Inc., 1947. 218 pp., illus., diagrs. $4.00.

German Scientific Establishments. Leslie E. Simon. (U.S., Office of Technical Services, PB 19849.) Brooklyn, N.Y., Mapleton House, 1947. 228 pp., illus., diagrs. $4.50.

Arbeitsvoraussetzungen und Führung Naturwissenshaftlicher und Technischer Forschung (Working Principles and Direction of Scientific and Technical Research). Adolf Bäumker. Munich, The Author, 1944. 271 pp. Printed as manuscript.

Before the final German surrender, Colonel Simon was sent to Europe to examine German scientific establish-

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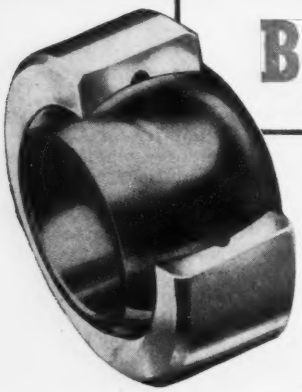

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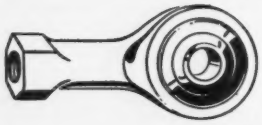

The self-aligning and shock resisting characteristics of HALFCO Bearings make them ideal for mechanical linkage systems. They may be used as ball joints, rod ends on actuating cylinders, or on linkages to accommodate motion in more than one plane.

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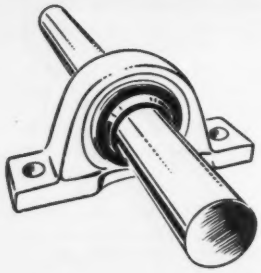

HALFCO Bearings have wide applications as rotation bearings for high load, slow speed installations. The self-aligning and axial thrust capacity features make them far superior to plain journal bearings for certain applications. A 360 degree oil groove assures positive lubrication.

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ments and to interrogate German scientists about research and development work in that country concerned primarily with ordnance. His original report covered establishments in central Germany west of the Elbe River. His book on German research in the war takes up first the organization of military, industrial, and civilian research and its functioning. In the second part, summaries of the more important research in ballistics, aerodynamics, instruments and measurements, and of the more important development work are made. The emphasis is on ballistics research, bombs, and rockets, including the R 4 M and the V-2. Details of wind tunnels and their instrumentation, especially new methods in interferometry, are included. In the final chapter the need for a strong fundamental and industrial research program in peacetime is clearly stated.

The original report, declassified and issued as PB 19849 by the Office of Technical Services, has been republished. This report is still useful. It contains data not included in the book and is especially useful for lists of the original German research reports.

Colonel Simon attributes the research organization of the Luftwaffe, described as the most extensive in the world, to Adolf Bäumker. Although not a scientist, Bäumker understood and appreciated science and was familiar with politics and the Luftwaffe. His detailed analysis of the principles for the organization of research on a national scale is informed with success in practice and is a sound statement of the problem, especially notable for the understanding shown of economic and psychologic factors.

60 Years with Men and Machines, an Autobiography. Fred H. Colvin, in Collaboration with D. J. Duffin. New York, Whittlesey House, McGraw-Hill Book Co., Inc., 1947. 297 pp., illus. $3.50.

Mr. Colvin started as a machine-shop apprentice in 1883, published his first article in 1886, became an editor in 1894, joined the *American Machinist* in 1907, served as a consultant on production problems to various government agencies during the war, and at eighty years of age was appointed a consultant on mechanical problems of the atomic-pile power project at Oak Ridge, Tenn. Although he has written nearly 7,000,000 words on machine tools and machine-shop problems, including over 40 technical books, his point of view seems as fresh as when he began. There is a good deal of excellent dialogue in this book and plenty of humor. Mr. Colvin enjoys a joke on himself. When he tackled the job of changing a tire on his air-cooled Franklin with the new demountable rims, his sons Charles and Henry made helpful and appropriate remarks, which he records. When he sailed over the 48-in. wheel of his Columbia bi-

cycle and landed under a sprinkling wagon, he does not omit the fact that the bike then ran over him. But, most of all, he has worked for efficiency in industry and improvements in machine tools and he has contributed immeasurably to the progress of the last 60 years.

Other Books Received

AERODYNAMICS

The Reynolds' Number; Its Meaning and Significance. J. Jennings. Manchester, England, Emmott & Co., 1946. 20 pp. 1*s*. The author states that the meaning of the Reynolds Number does not appear to be brought out clearly in the usual textbooks available to the engineer. The purpose of this monograph is to examine the structure of the number, explain its significance, and show how it may be calculated.

Flight of Birds, Bats, and Insects. Parts 1, 2. Frank W. Lane. London, Daily Mail, School-Aid Dept., 1947. 18, 17 pp., illus. 1*s*. 3*d*. each. Two well-illustrated booklets explain the principles of natural flight and how the study of them contributed to man's conquest of the air.

AIR TRANSPORT

Civil Aviation and the Export Trade. Norman J. Freeman. London, Institute of Export, 1947. 123 pp., illus. 6*s*. 6*d*. The book was written primarily for candidates for the examinations of the Institute of Export and presents chapters on the Background to British Civil Aviation, Prospects for the Future, Future Organization of British and World Airlines, Passenger and Freight Handling, Aviation Insurance and Aviation Insurance Law, and the Law of the Air Relating to Carriage by Air. Appendixes contain the texts of the Carriage by Air Act, 1932, Third Schedule to the Air Navigation Act, 1936, and specimen forms.

Beitrag zur Kostenlehre des Luftverkehrsbetriebs (Contributions to the Cost Theory of Airline Operations). Th. Stauffer. Zurich, Aero-Verlag, 1945. 120 pp., diagrs. The organization of an air line, using Swissair as an example, is outlined and the costs of operation are analyzed in detail. Accounting and bookkeeping methods are taken up next and the book ends with an analysis of the relation of volume of business to costs of operation. In a comparison of Swiss and American air-line operating costs, salaries and wages are shown to be greater in the United States while other costs are greater in Switzerland. There is a bibliography of German and Swiss sources.

AIRPORTS

Soil Mechanics, Its Principles and Structural Applications. Dimitri P. Krynine. New York, McGraw-Hill Book Co., Inc., 1941. 451 pp., diagrs. $5.00. A reissue of a standard textbook. The author's aim is to present the fundamentals of soil mechanics in simple and readable form, using mathematics only when necessary as a tool in the understanding of fundamentals. Use is made of the principle of continuity of strains, permitting establishment of limitations of theoretic formulas in a simple manner.

BIOGRAPHY

Journey to the End of an Era; an Autobiography. Melvin Hall. New York, Charles Scribner's Sons, 1947. 438 pp. $3.75. Colonel Hall's life has been an active one and it is evident that he has enjoyed it. He writes ably of what he saw in Europe and in the Far East while demonstrating airplanes to royalty and general staffs, negotiating and laying out an air line between Istanbul and Ankara, and serving as an active officer in two world wars. Espionage in Berlin in 1917, service as a British staff officer with King Albert of Belgium, officer under Gen. "Billy" Mitchell and in Italy, England, and Normandy in World War II give a further idea of the author's versatility. He began with an automobile tour of Europe and Asia before 1910.

Auf 16,000 Meter; Meine Fahrten in die Stratosphäre (At 16,000 Meters; My Travels into the Stratosphere). August Piccard. Zurich, Schweizer Aero-Revue A.G., 1933. 277 pp., illus. Technical details of Professor Piccard's balloons and his ascensions of 1931 and 1932, with some reprinted accounts of his earlier ascensions.

ELECTRONICS

Electronics for Industry. W. I. Bendz and C. A. Scarlott. New York, John Wiley & Sons, Inc., 1947. 501 pp., illus. $5.00. An explanation of the principles of electronic theory, vacuum tubes, and radio-frequency power generation as applied specifically to industrial uses of rectifiers, amplifiers, oscillators, high frequency heating, and electronic control and regulation. The book is intended for engineers familiar with electrical theory and devices, and provides supplementary reading lists at the end of each chapter for those who wish to obtain a more advanced understanding of basic theory.

ENGINES, GAS TURBINE

De Havilland Ghost Jet Propulsion Unit; Preliminary Statement. Edgware, Middlesex, England, The de Havilland Engine Co., Ltd., 1947. 34 pp., illus., diagrs. Design data, descriptions of the components, and technical data, curves, and drawings on performance characteristics.

Lectures on the Development of the British Gas Turbine Jet Unit. (Institution of Mechanical Engineers, Proceedings, War Emergency Issue No. 12.) New York, The American Society of Mechanical Engineers, 1947. 103 pp., illus. $3.00. A collection of ten lectures dealing with the design, development, and testing of British jet turbines, materials, requirements, and vibration problems.

FUELS

State Aviation Motor Fuel Taxes, Refunds and Exemptions; and Law Provisions Relating Thereto. New York, American Petroleum Institute, 1946. 23 pp. A compilation of the rates of taxation imposed by each state upon motor fuel used for aviation purposes, and the procedures necessary in each state to obtain exemption or refund of the tax when permitted by law.

HISTORY

Über Pole, Kontinente und Meer; Flieger Entdecken die Welt (Over Poles, Continents, and Seas; Fliers Discover the World). Carl Hans Pollog and Erich Tilgenkamp. Zurich, Aero-Verlag, A.G., 1944-1945. 2 Vols. 286, 276 pp., illus. These volumes contain accounts of famous flights selected from the history of aeronautics. Both balloon, airship, and airplane flights are included, ranging in the first volume from Alcock and Brown in 1919 to Lincoln Ellsworth's Antarctic flight of 1935, and in the second volume from Andrée's free balloon ascension of 1897 to the Moscow-Portland, Ore., flight of the Russians in 1937.

Eroberung des Himmels, Eine Geschichte des Fluggedankens (Conquest of the Skies, a History of the Ideas of Flight). Peter Thoene. Zurich, Aero-Verlag A.G., 1944. 265 pp., illus. This history was first published in Vienna in 1936. As a survey of the development of technical ideas and of concepts of flight it is a useful contribution. The author brings a wide knowledge of history to the task and is particularly able in the tracing of ideas through the entire range of philosophic and historical literature and events.

MAINTENANCE

The Aircraft Engineer's "A" Licence. G. W. Williamson. London, British Aviation Publications, Ltd., 1945. 256 pp., illus., diagrs. 17*s*. 6*d*. The British aircraft engineer licensed in category "A" is required to inspect all parts of the aircraft, except the engine installation, before flights and on account of minor repairs, modifications, and replacements. This book covers methods of measuring and checking, airplane construction, controls and control surfaces, landing gear, hydraulic systems, instruments, automatic pilots, electrical and other accessories, and maintenance and repair. Recommended reading and questions accompany each chapter.

The Aircraft Engineer's "C" Licence. G. W. Williamson. London, British Aviation Publications, Ltd., George Newnes Ltd., 1946. 256 pp., illus. 17*s*. 6*d*. A book prepared for the guidance of those studying for the "C" (Restricted) and "C" licenses of the Air Registration Board, covering the preflight inspection of the engine, its parts and accessories, the engine controls and instruments, and the propeller, and inspections on account of minor repairs, modifications, and replacements.

MATERIALS

ASM Review of Metal Literature, an Annotated Survey of Articles and Technical Papers Appearing in the Engineering, Scientific and Industrial Journals and Books Here and Abroad. Volume 2, 1945. Cleveland, American Society for Metals, 1946. 813 pp. $15. This second annual volume contains over 5,500 references, about 500 more than the first volume. The list of addresses of publications, presumably of those indexed, contains about 260 titles, or 90 more than the first volume. The number of foreign language journals covered is the same—five German, one Swedish, and one Swiss. The subject index in the 1945 volume contains about 25 per cent more entries. Some changes have been made in the classification. The inclusion of section and item numbers at the top corners of pages is an added indexing feature improving the ease of locating items by number. While this bibliography is made for the use of metallurgists and metal manufacturers, it has a value for aeronautical libraries, especially those which do not have files of *Chemical Abstracts* covering the literature for the year 1945.

Aluminium Alloy Castings, Their Founding and Finishing. E. Carrington. London, Charles Griffin and Co., Ltd., 1946. 326 pp., illus. 25*s*. A thorough review of processes in the making of aluminum-alloy castings, taking into account the wide knowledge built up during the war by this industry in the solution of production problems on a large scale, particularly for aircraft parts. Extensive bibliographies accompany each chapter.

Metallurgical Materials; Alloys and Manufacturing Processes. V. N. Wood. London, Chapman & Hall, Ltd., 1946. 340 pp., illus. 25*s*. Intended primarily for students, engineers, and others desiring a condensed reference source, this handbook presents in a simple, brief manner the metallurgy of the more commonly used metals, their manufacture, properties, testing, treatment, and fabrication.

Tungsten: Its History, Geology, Ore-Dressing, Metallurgy, Chemistry, Analysis, Applications, and Economics. K. C. Li and Chung Yu Wang. 2nd Edition. New York, Reinhold Publishing Corp., 1947. 430 pp., illus. $8.50. The first edition (1943) has been revised by the addition of more recent material to all chapters, particularly to those on the geology of tungsten and its industrial applications. There is a 6-page bibliography on tungsten alloys, and the lists of references at the ends of the chapters have been enlarged.

The Technology of Adhesives. John Delmonte. New York, Reinhold Publishing Corp., 1947. 516 pp., illus. $8.00. The importance of adhesives and their relationship to the development of plastics are emphasized, giving considerable weight to the utilization of synthetic resins in adhesive formulations to focus attention upon the latent possibilities of many compounds not fully explored. New discussions of the theory of adhesive action are given, to dispel the uncertainty

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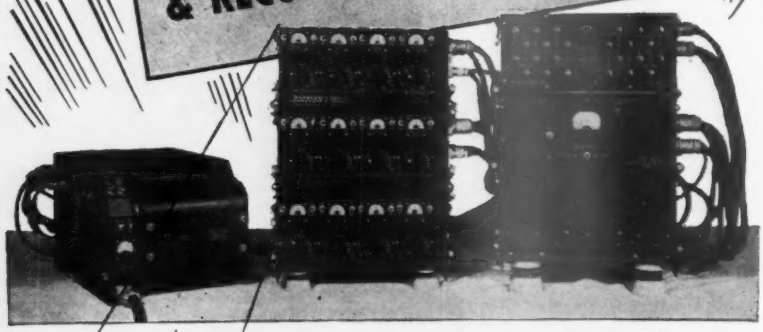
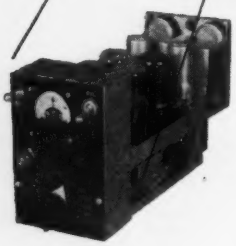
IN

ELECTRONIC MEASURING & RECORDING EQUIPMENT



Consolidated Unitized Static-Dynamic

10-kc. Carrier System "C"



COMPONENTS

Bridge Amplifiers
—Type 1-114. Unitized self-contained assembly
—Weight—3.5 pounds.

10-kc. Oscillator
—Type 2-106. Inherently stable phase-shift oscillator.

Power Supply
—Type 3-114 (12-volt D.C.) or Type 3-116 (115 volt,-50-400-cycle A.C.).

Recording Oscillographs
—Type 5-101B 14-trace.
—Type 5-114 18-trace.
—Type 5-115 36-trace.

This new development in measuring and recording equipment offers a light, compact system having high-frequency response, maximum sensitivity and stability. The accuracy of recorded static or dynamic information through a frequency range of 0 to 1,000 cps. is well within limits required by research laboratories and engineering development organizations.

The component Bridge-Amplifier Units plug into a rack-type case designed to hold four channels. The Oscillator and Power Supply, contained in separate cases, furnish current at rated voltages to operate a twelve-channel system. Four, eight or twelve channels may be employed as desired. All equipment is designed to withstand accelerations normally encountered in aircraft flight testing.

Write today for information concerning application of this equipment to your measuring and recording problems.

Consolidated Engineering Corporation

Designers and Manufacturers of Analytical Measurement Equipment

620 NORTH LAKE AVENUE • PASADENA 4, CALIFORNIA

and disagreement surrounding adhesive phenomena. The materials are classified chemically and according to their typical uses, as thermosetting and thermoplastic synthetic resins, cellulosic and starch derivatives, natural resins and oils, water-soluble gums, proteins, animal and fish derivatives, rubber or synthetic rubber adhesives, and inorganic adhesives. The composition, manufacturing processes, and uses are explained. Adhesives for wood, for organic plastics, for metal and rubber, for tapes, papers, cloths, foils, and for inorganic materials, and tests and specifications for adhesives are discussed in the final chapters.

Injection Molding of Plastics. Islyn Thomas. New York, Reinhold Publishing Corp., 1947. 534 pp., illus. $10. Introductory material on the history and development of injection molding techniques and machines is followed by chapters on materials for injection molding, molding practices, product design, mold design and construction, finishing and decorating, estimating and costs, and physical data. Over 500 photographs and drawings supplement detailed descriptions of the fabricating machines and tools and explanations of the injection processes, and show the products in various stages of manufacture. This volume should be a useful handbook for engineers, students, and others interested in the injection molding of plastics.

MATHEMATICS

Falk's Graphical Solutions to 100,000 Practical Problems. Karl H. Falk. Columbia, Conn., Columbia Graphs, 1946. 402 pp., diagrs. $6.00. About 400 worked-out graphs are presented. The greater part of the book is devoted to problems of mechanics, physics, mensuration of areas and volumes, and measures, with smaller sections on hydraulics, electricity, construction, chemistry, agriculture, medicine, and trigonometry. There is no index but the table of contents is detailed. Aeronautical subjects are found particularly in the sections on physics and mechanics.

MEDICINE

Aviation Neuro-Psychiatry. R. N. Ironside and I. R. C. Batchelor. Baltimore, The Williams and Wilkins Co., 1945. 167 pp. $3.00. A clinical guide written to provide a general picture of the neuropsychiatric approach to the psychologic problems of the air crew arising from operational hazards. Forty-four case histories are presented to illustrate neurotic reactions to injuries or severe environmental stress.

Principles of Anatomy and Physiology for Physical Training Instructors in the Royal Air Force. (*Gt. Brit., Air Ministry, Air Publication No. 3125.*) London, H.M. Stationery Office, 1946. 180 pp., diagrs. British Information Services, New York. $2.15. Includes chapters on mental and physical fatigue and flying fitness, preservation of general fitness among all types of personnel, and rehabilitation of medical and surgical cases.

Annual Report of the Board of Regents of the Smithsonian Institution, 1945. (Publication 3817.) Wash., U.S. Govt. Printing Office, 1946. 484 pp., illus. $1.75. The operations, expenditures, and activities of the Institution for the year ending June 30, 1945. Among the research papers published in the General Appendix is "Human Problems of Military Aviation," by Detlev W. Bronk (pp. 401–411), which recounts the wartime solutions to the problems of anoxia at high altitudes, excessive acceleration, improvement of night vision, and the psychologic evaluation of pilot efficiency.

METEOROLOGY

Meteorological Air Observer's Handbook. (*Gt. Brit., Meteorological Office, Publication No. 470.*) London, H.M. Stationery Office, 1945. 73 pp., illus. British Information Services, New York. $1.35. General principles and technique of flight measurements of atmospheric pressure, altitude, air temperature, humidity, and wind velocity; visual observation of clouds and

weather; ice formation on aircraft; condensation trails; and recording and reporting of observations. The latter half of the book consists of tables and procedures for the calibration of instruments and correction of readings.

Cloud Atlas for Aviators. 3rd Edition. (*Gt. Brit., Meteorological Office, Publication No. 450 (Air Publication No. 1875).*) London, H.M. Stationery Office, 1943. 19 pp., illus. British Information Services, New York. $0.55. A nontechnical description of the principal cloud formations and their significance, for pilots, navigators, and the flight crews.

Condensation Trails; Notes for Use of Pilots. (*Gt. Brit., Meteorological Office, Publication No. 480,* 1943.) London, H.M. Stationery Office, 1946. 5 pp., illus. British Information Services, New York. $0.10. Simple physical explanations of the trails left by airplanes flying at high altitudes, of which there are two main types: (a) those formed by condensation of water vapor from the exhaust, and (b) trails of aerodynamic origin.

Condensation Trails from Aircraft. (*Gt. Brit., Meteorological Office, Publication No. 479,* 1943.) London, H.M. Stationery Office, 1946. 10 pp., illus. 9 references. British Information Services, New York. $0.10. Theories governing the formation of trails behind airplanes flying at high altitudes and speeds are explained. Practical and theoretic results of studies on the formation of exhaust trails are followed by explanations of trails caused by pressure reduction.

PHOTOGRAPHY

The Principles and Practice of Surveying. Vol. 2—Higher Surveying. Charles B. Breed and George L. Hosmer. 6th Edition. New York, John Wiley & Sons, Inc., 1947. 674 pp., illus. $4.50. A revised edition of a well-known textbook, the last edition of which appeared in 1938. The section on photogrammetric surveying has been entirely rewritten, with revision of the order of presentation of material and of definitions and symbols to agree with recommendations of the Committee on Nomenclature of the American Society of Photogrammetry. This section includes a condensed chapter on ground photogrammetry, an enlarged and rewritten chapter on aerial photogrammetry, and a chapter on the theory and practice of stereo-photogrammetry. The principal revisions and new material in other parts of the book deal with triangulation, including recent developments in geodetic surveying, astronomical observations, barometric leveling, stadia slide rule and plotting stadia notes, stream gaging, and map projection.

PHYSICS

Electrons (+ and −), Protons, Photons, Neutrons, Mesotrons, and Cosmic Rays. Revised Edition 1947. Robert A. Millikan. Chicago, The University of Chicago Press, 1947. 642 pp., illus. $6.00. A revised edition of this work brings up-to-date the story of outstanding discoveries in physics of the last 50 years, including the release and utilization of nuclear energy.

RADAR

Radar Engineering. Donald G. Fink. New York, McGraw-Hill Book Co., Inc., 1947. 644 pp., illus. $7.00. A general compilation in one volume of information about radar theory and practice. The first part covers basic radar principles, the principles of pulse generation and transmission, transmission lines, waveguides, resonant cavities, radiators and reflectors, propagation, and targets. The circuits and components of radar equipment are dealt with in the second part. References to periodical literature are given at the end of most chapters. Knowledge of conventional radio theory and circuits, and college mathematics and electricity is assumed.

RADIO

Final Report, First Session, Special Radio Technical Division (COT). Montreal, Provisional International Civil Aviation Organization, 1947. 84 pp. $0.75. A detailed report of recommendations for instrument approach and landing aids, short-range navigation aids, long-range navigation aids, and airdrome zone aids for world-wide aviation use.

REFERENCE BOOKS

Aircraft Values Guide. Vol. 1, No. 3, January–March, 1947. Seattle, Leonard Publishing Co., 1947. 142 pp. Published quarterly, $10 per year. Almost the entire book consists of listings of the factory prices of the new 1947 personal airplanes available and the factory and used prices of personal airplanes manufactured from 1937 to 1946. The listing of each airplane includes a table of the principal specifications, such as the engine model and horsepower, number of seats, cruising and landing speeds, range, wing span, wing loading, and gross weight. A short paragraph follows which gives brief data on other performance characteristics, construction, and accessories. The Aircraft Values Guide is published in convenient pocket-size form and contains also useful information on financing, insurance, and C.A.A. registration forms and regulations. A table of C.A.A. airway mileages is given as an aid in estimating ferry charges.

Van Nostrand's Scientific Encyclopedia. 2nd Edition. New York, D. Van Nostrand Co., Inc., 1947. 1,600 pp., illus. $12. This revised edition of an encyclopedia, first published in 1938, encompassing the basic and applied sciences and engineering, contains new sections on electronics, radio metallurgy, meteorology, photography, and statistics. The sections on aeronautics, engineering, and navigation have been broadened and brought up to date. The arrangement of the terms, which number over 11,000, is alphabetical; cross references are plentiful. The method of discussion should make the book a valuable reference tool, both for the layman seeking a simple definition and for the scientist or engineer needing a detailed, technical explanation.

The World Almanac and Book of Facts for 1947. New York, *New York World-Telegram,* 1947. 912 pp. $1.00.

RESEARCH

Annual Report, October 1, 1945 to September 30, 1946, The Engineering Foundation. New York, 43 pp. Contains the financial report of the Foundation and progress reports on the activities and publications of research projects sponsored by the Foundation, covering such subjects as fluid mechanics, engineering materials, welding, lubrication, and friction.

ROCKETS

Moon Rocket. Arthur Wilcox. London, Thomas Nelson and Sons Ltd., 1946. 161 pp., illus. 7*s.* 6*d.* A review of the scientific problems involved in an attempt to reach the moon by rocket craft.

ROTATING WING AIRCRAFT

Designs for Helicopters. I. B. Laskowitz. Brooklyn, 284 Eastern Parkway, N.Y., The Author, 1947. 23 pp., diagrs. $2.00. A booklet containing the author's patent specifications and drawings of three different designs for helicopters with manual and automatic means for changing blade pitch angle. Outline drawings show the application of the principles to variable speed steering and variable pitch steering of coaxial rotors, and to main and auxiliary rotors.

STRUCTURES

The Use of Fourier Series in the Solution of Beam-Column Problems. B. F. Ruffner. (Bulletin Series, No. 21, August, 1945.) Corvallis, Ore., State Engineering Experiment Station, 1945. 64 pp., figs. $0.25. The application of Fourier series in representing the deflection curve for members simultaneously subjected to beam and column loads.

WORLD WAR II

Bomber Offensive. Sir Arthur Harris. London, Collins, 1947. 288 pp. 21*s.* The story of the building, from a nucleus of untrained men and obsolete machines, of the great force that carried out the 1,000-bomber raids on German-held Europe; the lessons learned from German bombing tactics; the achievements in planning and executing the attacks; and the effects of bombing on the German war effort, as discovered since the end of the war. It is of value as a historical document and as the views and memoirs of the wartime Commander-in-Chief of the Bomber Command.

I.A.S. National Meeting Schedule

Annual Summer Meeting—Los Angeles, Calif., Ambassador Hotel—August 7–8, 1947

Joint Meeting, The Royal Aeronautical Society—London, England—September 2–6, 1947

All correspondence should be addressed to The Meetings Committee, Institute of the Aeronautical Sciences, 2 East 64th Street, New York 21, N.Y.

AiResearch Builds "CABIN COMFORT" For Jet Medium Bombers

COMPRESSED AIR BLED FROM JET ENGINES AT 450° F.
COCKPIT PRESSURE REGULATOR
AIR ENTERS PRESSURIZED COCKPIT
COOLANT AIR
REFRIGERATION UNIT
Composed of expansion turbine and heat exchanger. COOLS AIR TO 35° F.
FLOW CONTROL VALVE
Regulates cabin temperature by controlling air flow through Refrigeration Unit.

One System Provides Complete, Automatic Control of Cockpit Pressure and Temperature

Air friction around the fuselage of a jet medium bomber boosts cockpit temperatures as much as 40-50° F. This heat must be overcome by introduction of cold air — but all air for the pressurized cockpit comes from the jet compressors at 450° F. Result — a tough cooling problem.

Most designers solve this problem with an AiResearch "Cabin Comfort" system, which provides both temperature control and pressurization. Key to "Cabin Comfort's" remarkable cooling efficiency is the revolutionary AiResearch expansion turbine. In the installation pictured above, a 10-pound turbine, operating at 48,000 r.p.m., cools air 135° at 20 pounds airflow per minute!

AiResearch "Cabin Comfort" equipment is being furnished for the newest planes of Douglas, Lockheed, Consolidated Vultee, Boeing, North American, Republic and Northrop.

AiResearch leadership is based on seven years of pioneering research and production. Call upon this unique background to help solve *your* problems in aircraft air control. AiResearch Manufacturing Company, Los Angeles 45, Calif.

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Services of the Libraries of the Institute of the Aeronautical Sciences

The services of the Libraries are available to all members of the Institute, to Corporate Members, to advertisers in the AERONAUTICAL ENGINEERING REVIEW and AERONAUTICAL ENGINEERING CATALOG, and, under usual library limitations, to the public. Four specialized services are available.

The Paul Kollsman Lending Library

This lending library service makes available, *without charge*, the latest and more important aeronautical books.

Members may request the loan of any aeronautical or technical book they wish to borrow. Through an exchange agreement with the Engineering Societies Library, any book on general engineering may be borrowed from its great collection of over 160,000 volumes.

A photostating service is available at usual library rates.

Applications for membership in the library and further information will be sent on request.

The W. A. M. Burden Reference Library

This reference library contains over 12,000 aeronautical books, magazines, pamphlets, and reports gathered from world-wide sources and is one of the most complete aeronautical libraries in the world. Material from this library is not available for loan but may be used for reference purposes.

The Pacific Aeronautical Library

6715 Hollywood Boulevard
Los Angeles 28, California

Established in cooperation with the aircraft companies the library serves. The leading aircraft companies in or near Los Angeles participate in its support and operation.

This service library for aeronautical research is available to the public for reading privileges. Source material includes aerodynamic and structural research reports, as well as books on drafting, production methods, history, and allied sciences. It furnishes books, periodicals, and pamphlet material to the participating aircraft companies to supplement their engineering libraries.

Technical Information Service

This service has experienced personnel under the supervision of trained aeronautical engineers to compile any information desired. The services range from listing specialized reference books to the preparation of exhaustive bibliographies, digesting of reports, and general surveys of any aeronautical subject. Some of the available services are:

Bibliographies on any aeronautical subject.
Reports on any aeronautical subject.
Digests of aeronautical books, papers, periodicals, and references.
Translations.
Engineering investigations of special aeronautical subjects.
Biographies of individuals engaged in aeronautics.
Photostats of any aeronautical or general engineering material.
Microfilms made on special order.
Photographs made from the Institute's photographic collection.
Drawings and tracings made.

In addition to the services mentioned any commission which comes within the scope of the Service will be accepted. Special arrangements may be made for work requiring several weeks or months.

Translators are available for accurate transcriptions of all foreign language data. Translations are carefully edited by trained engineers.

Reproductions of any material in the collections of the Institute may be ordered at standard photostat rates.

INSTITUTE OF THE AERONAUTICAL SCIENCES, INC.
2 EAST 64th STREET, NEW YORK 21, N.Y.

Martin Memo

Published by The Glenn L. Martin Company
Baltimore 3, Maryland

Martin Military Transport . . . The Martin 2-0-2 commercial transport, now in production for 15 leading airlines, cruises a hundred miles an hour faster than prewar twin-engine transports. Plans for a military version of the speedy transport reveal that it can carry 50 completely equipped soldiers or 15,000 pounds of cargo. Large doors make possible the easy loading of heavy military equipment.

Low-Cost Maintenance . . . is built into the Martin 2-0-2 transport. Numerous doors and panels give easy access to important maintenance locations and facilitate routine inspections. Fast underwing fueling cuts service time. Time saved here means lower maintenance costs.

Large Orders Cut Cost . . . Martin has orders for more new transports than any other manufacturer. These big orders spread first production costs over a large number of planes . . . give purchasing airlines these modern transports at lower cost.

Marvinol . . . the plastic raw material, developed by Martin research, has proved to be a useful material in the production of aircraft. Light, hard-wearing Marvinol provides the cabin of the Martin 2-0-2 with smart scuff-proof wall and floor coverings and upholstery. It will soon be used in many other locations in airplanes.

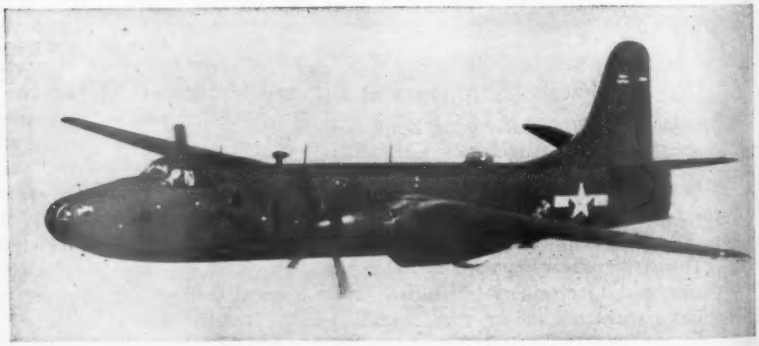
Cargo Version . . . of the Martin 2-0-2 will carry 15,000 pounds of cargo at express speeds. A large six by eight foot cargo door makes for fast, easy handling of large and small items. A variety of fittings (bins, racks, shelves, refrigerator units) enables operators to handle any type of cargo with speed and efficiency. The Martin 2-0-2 cargo plane can be operated for as little as 5½ cents per ton-mile.

Increased Profit Margin . . . Carrying 36 to 40 passengers (almost twice as many as prewar twin-engine airliners), the Martin 2-0-2 needs only eighteen passengers to break even. The large load carried by this speedy airliner enables airline operators to increase profits without increasing operating costs.

Cuts Operating Costs . . . The high cruising speed of the Martin 2-0-2 enables airline operators to speed up schedules . . . fill seats with satisfied passengers . . . cut turn-around time . . . complete more trips between inspections. In short, the 2-0-2 cuts per-mile operating costs and increases airline profits.

Proved in Flight . . . Already many hours in the air, the Martin 2-0-2 will soon be flying the world's skyways for these great airlines and cargo carriers: Capital (PCA) . . . Eastern . . . Chicago & Southern . . . United . . . Northwest . . . Delta . . . Panagra . . . Cruzeiro do Sul (Brazil) . . . Aeroposta (Argentina) . . . Nacional (Chile) . . . Mutual . . . Flying Tiger . . . Air Borne Cargo . . . U. S. . . . Willis.

Martin Advanced Research . . . Having recently acquired the assets and patents of Rotawings Inc., The Glenn L. Martin Company has added the field of rotary wing aircraft to its extensive list of advanced scientific fields undergoing study in the Martin research laboratories. This new division of The Martin Company will carry on experiments and research in control systems and rotary hubs and blades. Other advanced scientific fields being studied by Martin include electronics . . . trans-sonic speeds . . . jet propulsion . . . rocketry . . . plastics . . . guided missiles . . . and others.



Jet Power . . . Navy's newest patrol plane has a top speed of well over 350 m.p.h. . . . range of 3,000 miles. Designed and built by Martin, the XP4M-1 has two jet engines for high speed spurts . . . and two conventional engines for long range. The four engines are mounted in two nacelles, giving the appearance of an ordinary twin-engine aircraft.

Martin AIRCRAFT
Builders of Dependable Aircraft Since 1909

Personnel Opportunities

This section is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Educators and Specialists—Pacific Northwest opportunity for aeronautical educators and engineering specialists. Advanced degree required, plus enthusiasm for graduate teaching and research. Excellent laboratory facilities available. Address inquiry to Aeronautical Engineering Department, University of Washington, Seattle 5, Wash.

Aerodynamicist—Person familiar with calibration of and testing procedures in high-speed wind tunnels to direct these activities on a new tunnel. Reply should contain information concerning education, experience, and when available and should be addressed to the Employment Office at Cornell Aeronautical Laboratory, 4455 Genesee Street, Box 235, Buffalo 21, N.Y.

Controls Engineer—Experienced, for development of controls and valves associated with large rocket propulsion systems in guided missiles program. Desired background: electrical or mechanical engineering degree and minimum of 5 years' experience in the practical development of valves, servomechanisms, and automatic controls. Address reply to Engineering Personnel Office, North American Aviation, Inc., Municipal Airport, Los Angeles 45, Calif.

Research Engineers and Physicists—Engineers, physicists, chemists, and mathematicians with research experience in problems related to aeronautics are needed by the National Advisory Committee for Aeronautics. Salaries for various positions requiring research experience range from $3,397 to $9,975 per year, depending on the type and level of work. Entrance positions for college graduates pay $2,644 per year. Areas of research include the following: aerodynamics, hydrodynamics, structures, materials, thermodynamics, compression and turbines, fuels and combustion, lubrication, mathematics, optics, electronics, radar, telemetering, servomechanisms, and other fields. Applications for positions or requests for further information should be addressed to the personnel officer at one of the following laboratories: Langley Memorial Aeronautical Laboratory, Hampton, Va.; Ames Aeronautical Laboratory, Moffett Field, Calif.; Aircraft Engine Research Laboratory, Cleveland.

Aircraft Equipment and Accessory Engineer—Excellent opportunity for graduate A.E., M.E. or E.E. with at least 4 year's practical experience as application engineer on electromechanical actuators, electric motors, and automatic control for aircraft. Reply to Lear, Incorporated, 110 Ionia Ave., N.W., Grand Rapids 2, Mich.

Electronic Engineer-Pilot—A position is open for a highly qualified electronic engineer who is also an expert multiengined pilot. The work will consist primarily of flight research and test of aeronautical automatic controls of many descriptions. The engineer will be involved from the inception of an idea or device, through its development stages, in the planning and flying of the tests, to the final demonstration and sales stages. It is desirable that the applicant be skilled in instrument and airways procedures or is a former air-line, N.A.T.S., or A.T.C. pilot. Apply by letter, giving engineering and flight experience and starting salary expected, to Chief Flight Test Engineer, Minneapolis-Honeywell Regulator Company, 2753 Fourth Ave. S., Minneapolis.

Engineers—Young engineering graduates with up to 3 years' experience required for test activity and aerodynamic or thermodynamic analysis on extensive and continuing development programs on nonrotating aircraft power plants. Mechanical or aeronautical engineers preferred. Address reply to Continental Aviation and Engineering Corporation, Detroit 14.

Aerodynamicists—College graduates with sound theoretical training and at least 1 year of graduate study in compressible subsonic flow and supersonic flow to do research and test work in the Supersonic Wind Tunnel of the Ballistic Research Laboratories, Aberdeen Proving Ground, Md. This is one of the few operating supersonic wind tunnels in the country having a test section larger than 1 sq.ft. Remuneration in accordance with qualifications. Write, giving education and experience, to The Commanding General, Aberdeen Proving Ground, Md., Attention: Director, Ballistic Research Laboratories.

Structural Designers—Experienced in sheet-metal aircraft structures for new helicopter design. Graduate engineers from recognized universities preferred. Plant located in suburb of West Philadelphia. All replies will be held confidential. Write Personnel Department, Piasecki Helicopter Corporation, Sharon Hill, Pa.

Layout Draftsmen—Five or more years' experience on aircraft layout and design. Rotary wing preferred. Graduate engineers from recognized universities preferred. Plant located in suburb of West Philadelphia. All replies will be held confidential. Write Personnel Department, Piasecki Helicopter Corporation, Sharon Hill, Pa.

Aerodynamicist and Vibration Specialist—Experienced in rotary wing field. Graduate engineers from recognized universities preferred. Plant located in suburb of West Philadelphia. All replies will be held confidential. Write Personnel Department, Piasecki Helicopter Corporation, Sharon Hill, Pa.

Assistant Designer—Wanted immediately by Canadian branch of leading aircraft hydraulics and landing-gear specialists. Must be capable of taking full responsibility for undercarriage design projects, and should have had some experience in design of hydraulic pumps, systems, and electro-hydraulic units. Knowledge of stress analysis and familiarity with both British and American engineering practices also desirable. This is a permanent position with good prospects. Starting salary $275 to $300 per month, depending on qualifications. Apply in writing to Chief Engineer, Dowty Equipment (Canada) Limited, 999 Aqueduct St., Montreal 3, Canada.

Senior Draftsman—Wanted immediately by Canadian branch of leading aircraft hydraulics and landing-gear specialists. Must have minimum of 3 years' experience in the more mechanical side of aircraft design work and, preferably, 1 year's design experience on undercarriage and hydraulics, variable-pitch propellers, fuel systems, or other similar accessories. Should be capable of detailing any undercarriage or hydraulic layout and of carrying out elementary stress analysis. Familiarity with both British and American engineering practices also desirable. This is a permanent position with attractive prospects. Starting salary proportional to qualifications offered. Apply in writing to Chief Engineer, Dowty Equipment (Canada) Limited, 999 Aqueduct St., Montreal 3, Canada.

Assistant or Associate Professor—To teach courses in aerodynamics and wind-tunnel and airplane design. Must have graduate work in aerodynamics. Prefer man with teaching and practical experience. Salary and position will depend upon qualifications. Applicants should submit detailed record of education and experience. Address reply to Aeronautical Engineering Department, University of Kansas, Lawrence, Kan.

Aerodynamicists and Aeronautical Engineers—Positions available for highly qualified technical personnel with good theoretical or experimental background to engage in development and test work in stability, control, high-speed, and supersonic aerodynamics. Projects include new designs of piloted and pilotless aircraft, new wind tunnels and associated equipment, and advanced testing techniques. Salary in accordance with qualifications and Civil Service regulations. In reply please give brief summary of personal qualifications, education and experience. Address: Director, David Taylor Model Basin, Washington 7, D.C.

730. **Aeronautical Engineer**—Civil Service position open in Washington, D.C., for aeronautical engineer with experience in stability and control analysis. Salary $4,902 per annum. In applying please give brief sketch of personal qualifications, education, and experience.

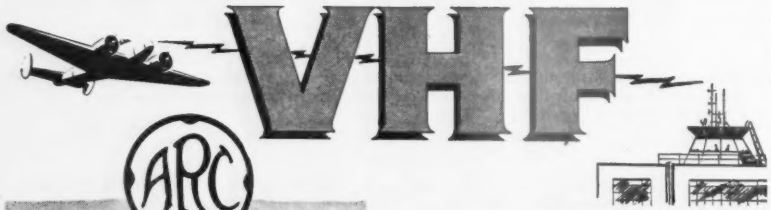
724. **University Airport Operations Director**—Director of Operations position available at airport owned and operated by a large mid-western university. The director should be a pilot and a graduate engineer, have had some experience in operating an airport, and have an interest in flight research and flight training.

718. **Aerodynamicists**—Services of several highly qualified aerodynamicists are required by a Midwest firm investigating supersonic wind tunnels for Government facilities. Preference given to those with experience in design of compressors, nozzles, refrigeration and drying equipment, and wind-tunnel instrumentation. A good background in supersonics, mathematics, and physics is preferred but will consider others with subsonic experience in above fields. Applicants should write giving complete details of education, experience, and salary expected.

706. **Assistant Professor**—To teach courses in aircraft structures and aircraft structures laboratory at an Eastern university. The primary duties of the position will be concerned with aircraft structures, but the applicant should possess enough knowledge of aerodynamics to permit him to assist occasionally in elementary aerodynamic courses. Prefer a man with teaching and practical experience. In applying, please give brief sketch of personal qualifications, education, and experience.

The number preceding the notices represents the Box Number of the Institute of the Aeronautical Sciences to which inquiries should be addressed.

The Practical Approach to . . .



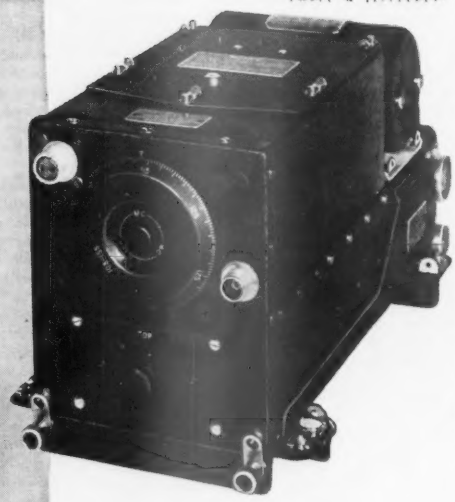
VHF

ARC

R-13

Tunable VHF RECEIVER

ALLOWS THE PILOT TO SELECT ANY OF THE PRESENT OR PROPOSED VHF COMMUNICATION AND NAVIGATION FREQUENCIES



The A.R.C. R-13 is engineered to provide a tuning accuracy and frequency stability unusual in tunable receivers. Its selectivity and freedom from spurious responses makes it a suitable basic receiver for modern airborne VHF Multi-channel communication and navigation systems.

• • •

The R-13 alone provides communication reception on all VHF frequencies currently assigned or proposed for aviation use. By adding the simple F-10 Filter-Amplifier unit it can also be used for navigation by means of the new VHF Localizers and Visual-Aural Ranges. Further addition of a B-10 Converter unit and necessary instrumentation provides complete VHF Omni-Directional Range navigation facilities. There need be no worry that the receiver will become obsolete through limitation on the number of channels that can be selected.

For complete 2-way VHF communication between air and ground, the A.R.C. Type 18 VHF Transmitter is recommended as an ideal, lightweight companion equipment.

• • •

To insure immediate and continuing utility, make the A.R.C. Tunable Receiver the heart of your multi-channel VHF communication and navigation system, and add other A.R.C.-engineered units as needed to meet your specific requirements.

GOOD DESIGN TAKES TIME

Over four years of specialized engineering development have led to the current production of the tunable VHF Receiver which is the heart of the A.R.C. multi-channel VHF systems. All A.R.C. units are built to meet the rigid requirements of the CAA for Approved Type Certification.

ARC

Aircraft Radio Corporation

Boonton, N. J.

DEPENDABLE ELECTRONIC EQUIPMENT SINCE 1928

679. Professor of Aeronautical Engineering—To take charge of work in established department of aeronautical engineering at a large engineering college. A man with graduate degree, teaching and industrial experience preferred. Rank and salary dependent upon educational background and experience.

671. Instructor or Assistant Professor—Sought by Aeronautical Engineering Department of Southwestern university. Should have master's degree and be able to teach in fields of aerodynamics and fluid mechanics, structures, and power plants and be capable of specializing in one of these.

670. Research and Aerodynamics Engineers—Long-term helicopter development program for Army Air Forces requires additional experienced and capable engineers. Exceptional working conditions and opportunities. Work involves aerodynamics, vibration, and flutter analyses on advanced designs. Substantial experience in aerodynamics or vibration work essential. East Coast company.

651. Aeronautical Administrative Engineer—Experienced in handling Navy Contract procedures and in designing for production. All replies will be held confidential. East Coast company.

AVAILABLE

738. Aviation Representative—Executive. Married. Seven years' air-line experience. Possesses good working knowledge of all departments. Broad communications experience—supervisory and administrative. Some flying experience plus working knowledge of dispatching, meteorology, instrument flying, and navigation. Alert, reliable, mechanically inclined. Executive ability. Interested in organizing a helicopter operation, or cargo or feeder air-line. Will consider responsible position with an organization needing a well-informed aviation representative. Will furnish references on request. Interview desired.

737. Engineer—Age 33, married. Aeronautical and mechanical engineering education. Nine years' experience in aircraft industry including all phases of design and analysis of airplane structures. Would like position with growing concern. East Coast preferred.

736. Spare Parts Requirements Specialist—Graduate of 2-year aeronautical engineering technical college; C.A.A. mechanic's license; 3 years with A.T.C. and A.T.S.C. as assistant aircraft maintenance officer specializing in scheduling the repair of spare parts and anticipating need for same before actually needed. Presently employed and has 2 years' experience with a major air line, mainly in provisioning spare parts. Has a thorough practical knowledge of engineering and maintenance problems and practices. Desires connection with an air line or company planning to enter the air transportation business. Preference is New York Area.

735. Engineer—B. of A.E., 1942, with honors. Postgraduate study in mathematics. Training background includes extensive experience as a machinist and as a draftsman. Flying experience. Experience as development engineer working on all phases of aircraft propeller theory, testing, and production. Two years as an engineering officer in the U.S. Navy. Last duty as an administrative engineer with the Office of Research and Inventions. Experience with large aircraft company as a research aerodynamicist working on subsonic and supersonic rocket aircraft. Design engineer, procurement engineer, and sales engineer with mechanical machine company. Exceptional administrative and sales ability. Personable appearance and can deal effectively with people. High engineering aptitude and understanding proved many times in practice.

734. Aircraft Equipment Engineer—Age 33, married. Fourteen years' experience, including: 1½ years as aircraft mechanic; 2½ years as assistant chief engineer small aircraft plant; 1½ years as group leadman on experimental aircraft project, doing layout, lofting, stress analysis, weight and balance; 8 years with major aircraft company as layout draftsman, engineering designer, shop liaison engineer, modification and salvage engineer. Research and development work on passenger comfort and lightweight seating. Familiar with Army and C.A.A. regulations. Desires chance for advancement with manufacturer, research organization, or maintenance base. Prefers West Coast.

733. Engineer—Nine years' experience in manufacturing and materials and process engineering. Also some experience in stress analysis, structural testing, and design. Desires position in materials and processes, research, production design, or manufacturing field with air-line, airframe, or accessory manufacturer.

732. Chief Power-Plant Engineer—B.S. in M.E. Twenty years' experience in airplane design as draftsman, weight computer, stress analyst, flight test observer, project engineer, power-plant engineer, and chief power-plant engineer. Fifteen years as power-plant installation specialist. In charge of power-plant design and technical calculations for many outstanding military and commercial airplanes. Turbojet and rocket experience. Successful administrative record in handling design groups. Desires administrative position with progressive firm in engineering department of aircraft company or in installation department of engine manufacturer.

731. Aerodynamics; Design; Structures; Management—Experienced in all phases of aircraft design and manufacturing. Ex-assistant chief engineer, chief aerodynamicist, chief of stress, project engineer. University of Michigan graduate, B.S. Ae.E., B.S.M.E. Age 30, married. Desires work in New York City vicinity. Complete information given on request.

729. Plastics Engineer—B.S. in M.E., Cornell, 1940. Age 30, married. Wishes to organize low-pressure molding department or section of laboratory for aircraft concern designing surfaces that must carry radar equipment or have supersonic smoothness. Five years' experience in aircraft applications of plastic resins, thoroughly familiar with practical laboratory and production techniques; also with design and lofting requirements for low-pressure molds.

728. Aeronautical Engineer or Teacher—B.S. Ae.E., now completing master's work at the University of Michigan in aerodynamics, propulsion and research techniques. Received Rotary Wing Scholarship in 1946. Reads and speaks French and German. Has done tutoring in physics and aeronautics. Three years' experience as assistant project engineer on development, design, and manufacture planning for aircraft instruments and subsonic wind tunnel. Two years' experience in A.A.F., personally responsible to Chief of Maintenance, for 3rd echelon maintenance on all C-47, C-53, and P-38 aircraft in the Ninth Air Force. Desires engineering position in supersonic research, rotary wing field, or as teacher in aerodynamics, propulsion, structures, or rotary wing subjects.

727. Tool-Production Engineer—Age 34. Fifteen years' experience sheet metal and precision metalworking fields in production supervision, tool design, aircraft layout drafting, production engineering. Last 8 years in aircraft, last 2 years as Chief Tool Engineer. Capable administrator, considerable experience in labor relations. Desires position in tool or production engineering leading to responsible position requiring administrative ability.

726. Aeronautical Engineer—B.S. in Ae.E., 1942, plus additional engineering studies. Age 25, single. Five years' experience, including 3 years' layout design and 2 years' engineering experience in another field having to do with the fabrication and production design of ceramic product. Experience in processing, testing, research, and field service in capacity of Practical Engineer. Prefers position in administrative capacity, field service or design group. Free to travel anywhere. Complete information will be given on request.

725. Airplane Structures Engineer—B.S. in M.E. from recognized state university. Five years' experience in airplane structural design, major stress analysis and air loading with leading aircraft manufacturers and 3 years of experience with Federal Government agencies having cognizance of aircraft airworthiness. Some teaching experience and author of text on flight loads. Present employer closing plant July 1. Desires position in aeronautical or mechanical engineering or teaching involving structural design, stress analysis, fluid mechanics, or other analytical or research work.

723. Aeronautical Engineer—Young Puerto Rican, 20 years old, American citizen; graduate of Academy of Aeronautics, February, 1947. Speaks and writes Spanish. Will accept position in New York, Puerto Rico, or South America.

722. Research Engineer—Age 29, married. B.S. Ae.E., 1943. M.S. Ae.E. expected June, 1947. Three and one-half years' research experience including general aerodynamics and subsonic and supersonic wind-tunnel testing. Supervisory experience.

721. Engineering Writer—B.S. degree in Aeronautical Engineering, Purdue. M.S. in Journalism. Married; 23 years old. Has taught aircraft structures and mathematics. Wants to work with a technical publication as assistant editor or similar post. Although magazine work is preferred, will consider any position that would draw upon engineering and writing training. Would be interested in college teaching.

720. Development or Design Engineer—Twelve years' specialized in power plant installation, design, test, research and proposal work as designer, group engineer and senior project engineer. Also familiar with design, test, and performance calculations of exhaust ejector pumps and thrust augmenters, and some design of ramjet engines. Five years' air-frame design experience and 5 years' diversified shop, tool engineering, and plant engineering work. Since end of war, partner in a small Midwestern engineering company doing some work on airplane component design. Well versed in organizing and follow through of projects and in dealing with personnel. Born, graduated, and 5 years' engine-design experience in Germany. In United States since 1929; citizen since 1935; age 45; married. Desires position with airplane or component manufacturer or operator as a design development, test, field, or maintenance engineer. Starting salary and location secondary if opportunities are right. Available immediately.

719. Aeronautical Engineer—B.S. degree in Aeronautical Engineering; graduate work, majoring in physics; age 31. Eight years' aeronautical engineering experience, consisting of 6 years in stress analysis, structural testing, and structural design criteria development and 2 years in preliminary aircraft design. Thoroughly experienced in aerodynamics, aircraft structures, and design. Capable as a project engineer and in the supervision of engineering and laboratory personnel. Desires position requiring initiative and responsibility in which engineering experience and background will be of value.

717. Aeronautical Engineer—M.S. in Ae.E.; A.B. in mathematics. Four years' experience in stress analysis, flutter, and vibration with leading aircraft firms. Interested both in teaching and in industry, preferably in New York area.

716. Pilot—Position wanted as pilot for private concern with sales engineering possibilities. B.S. in Ae.E. Four years' engineering experience with airplane manufacturers. Four and one-half years' air-line experience in twin-engined and four-engined equipment; 2,600 hours' logged time. C.A.A. ratings held—commercial, single- and multiengined land, instrument, and instructor. Free to locate anywhere but Chicago preferred.

715. Instrument Engineer—B.E.E., Cornell University, 1943. Four years' experience with recording and indicating instrumentation in flight test division of leading aeronautical research laboratory. Developed instrumentation and calibration techniques and supervised the installation and maintenance shop personnel. Desires position with aeronautical laboratory or instrument manufacturer.

714. Aeronautical Engineer—B.S., Rensselaer Polytechnic Institute. Age 24. Well experienced in the structural analysis and design development of supersonic military aircraft and missiles. Additional experience and background include aerodynamics major as undergraduate and 3 years in U.S. Navy as aircraft engineering officer-specialist in structures and engine maintenance and repair. Desires permanent position with West Coast aircraft concern. Prefers to continue work in supersonic research and development in either structures or aerodynamics.

713. Manufacturers Representative, Sales, or Field Engineer—Engineer with 17 years' aeronautical design, plus 3 years of successful aircraft sales engineering experience. Has technical, executive, and sales ability. Desires connection with distributors or manufacturers to handle products selling to West Coast aircraft industry. Well known to both engineering and purchasing personnel of California aircraft companies. Available immediately.

712. Materials, Processes, and Standards Engineer—M.E. degree; seeks position with aircraft or metal fabricating plant in New York Metropolitan area or Long Island. Excellent record: nationally known author; prominent welding consultant; authority on materials, processes, and standards; research; design; administration; production; industrial engineering; estimating. Presently employed with one of America's foremost aircraft companies.

711. Professor of Aeronautical Engineering—B.S. in M.E.; M.S. in A.E. Five years' teaching experience as Associate Professor of Aeronautical Engineering, in well-established engineering college. Five years' varied industrial experience, including development work on guided missiles. Desires permanent position in recognized engineering college teaching airplane design and aerodynamics. Primarily interested in research and development of light planes. Available immediately.

710. Aeronautical Engineer—Married; age 30. Four years' experience in structures and static test. Experience in electronic instrumentation for testing. Six months at Wright Field as company representative for static test of large airplane. Two years' experience in structural and mechanical design for high-speed variable density wind tunnel. One year in Navy radar program. Now attending California Institute of Technology. Will obtain M.S. in Aeronautics in June. Would like industrial research or teaching and research with work toward a higher degree. Available in June.

709. Aeronautical Engineer—B.S. in Ae.E. Experience includes structural testing, drafting, and liaison on both military and commercial aircraft. Seeks position in structural testing or wind-tunnel testing. Location open.

708. Aeronautical Engineer—Financially independent, as the result of successful designs,

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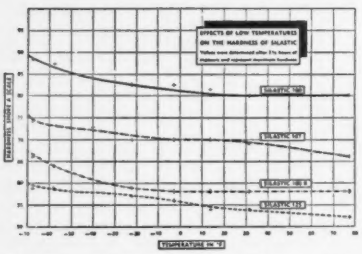

Silastic remains flexible at lower temperatures than any other rubber-like material, and still keeps its resilience at temperatures far above the limits of any natural or synthetic rubbers. The graph reproduced above shows how little the various kinds of Silastic increase in hardness at temperatures down to −70° F.

In every case, the values given in this graph are the maximum durometer readings obtainable at the test temperature. Even more important in many low temperature applications is the fact that these same hardness values will be obtained even after the test samples have been exposed for an indefinitely long period of time at 300-350° F.

Brittle points are also of primary importance to anyone seeking a rubber-like material useful at both extremely low and high temperatures. The brittle points of the various kinds of Silastic were determined by holding the samples at progressively lower temperatures for 5 hours.

Brittle point values ranging from −70° F. to −100° F. are given in the table below.

BRITTLE POINTS OF SILASTIC
(ASTM D 736-43T)
after 5 hours exposure to test temperature

Silastic	° F.	° C.
120	−90 to −100	−68 to −73
125	−90 to −100	−68 to −73
150	−70	−57
160	−70 to −90	−57 to −68
160 Red	−90	−68
167	−80	−62
180	−90	−68
181	−80	−62

For information about Silastic as a gasketing material write for leaflet No. S 13-1.

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desires new position on West Coast with sufficient authority or scope to be able to obtain results. Successful projects previously headed, both commercial and military, will be furnished as proof of ability to lead either design or research developments. Salary is of minor importance.

707. Sales Engineer—Engineer with 27 years' experience in aircraft engineering and manufacturing. Has ingenuity and engineering ability combined with sales ability. Desires sales engineering connection in Los Angeles area in any field requiring these characteristics.

705. Aeronautical Engineer—Former pilot; long and broad experience in nearly all phases of airplane design, manufacture, and operation. Lately specializing in gas turbines and hydraulics. Especially interested in development.

704. Aeronautical Engineer—Seventeen years' experience on airplanes and 2 years on helicopters as layout man, group leader on drafting, design draftsman, chief draftsman, project engineer, design engineer, and assistant chief engineer, concerning commercial and military aircraft. College education and 5 years' original experience in mechanical engineering.

703. Aeronautical and Aircraft Maintenance Engineer—B.Ae.E., N.Y.U., 1944. Two and one-half years' overhaul, maintenance, modification, and repair of single- and multiengined aircraft in both military and commercial aviation, plus previous limited association with manufacturing industry. Seeks a responsible engineering position to which adaptable in either manufacturing industry or air transport. Will consider overseas employment.

702. Engine Research Technician and Draftsman—College background; 2 years' aeronautical engineering; 29 years old; married. Nine years of technical and practical experience in aircraft-engine production and development. Thorough familiarization with engine design and development, laboratory testing and research, engineering analysis, and layout and detail drafting. Two and one-half years' experience with gas-turbine and jet propulsion engineering projects at U.S. Navy Air Test Research Center. Desires permanent position with leading engine manufacturer or experimental development unit in research, development, designing, or liaison capacity, preferably in New England or Eastern Coastal area.

701. Mechanical Engineer—Age 30; B.S. and M.S. degrees. Two and one-half years' aircraft-power-plant installation design and development. Three and one-half years' aircraft gas-turbine thermodynamic analysis involving design of turbine and compressor elements and performance evaluation. Both jet and prop-jet experience. Desires responsible position on gas-turbine or allied power-plant work having good growth possibilities. East Coast area preferred.

700. Project Engineer—Age 36. B.S. in M.E., plus some postgraduate work. Nine years' experience in production and development of electromechanical instruments. This work has included considerable time spent with laboratory, manufacturing, and inspection groups and also with customers on related engineering problems. Especially interested in cost-reduction work. A complete outline of experience and qualifications will be sent upon request.

699. Chief Inspector or Experimental Department Head—Twenty years' experience in the aircraft industry, including experimental, quality control, and production analysis. Seeks position as chief inspector or head of experimental department. Location open.

698. Engineer and Executive—Almost 30 years' experience on airplane and accessory design, airport selection and layout, and airplane operations engineering. Good organizer and manager; sound business experience; capable technical writer; wide knowledge of materials and processes.

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697. Aircraft Structural Engineer—Graduate engineer, B.S. in M.E., Ae.E. Two years' aircraft structural design and research experience. Design experience gathered with both military and personal aircraft. Thoroughly familiar with C.A.A. requirements and static testing. Structural research experience gathered while in the Army Air Forces. Desires position in structural design or structural research department. Will locate anywhere.

696. Aeronautical Engineer—B.S. in Ae.E., New York University (Guggenheim School of Aeronautics). Almost 2 years' mechanical training and experience in the A.A.F. Six months' experience with small West Coast aircraft company performing design and stress analysis of major components of prototype airplane under supervision of chief engineer. At present, graduate student at M.I.T., specializing in rotary wing aircraft working toward S.M. in Ae.E. Good grades throughout schooling. Desires position with progressive helicopter company. Available about July 1. Details and references upon request.

695. Administrative Engineer—Age 40; 6 years in aircraft engineering department, from design engineer to managing the department of approximately 2,000 people. Past year personnel manager of newly organized aircraft maintenance base. Previous experience as an instructor in aeronautical subjects and draftsman. Desires permanent position, preferably in aircraft, involving engineering and personnel administration. Location open.

694. Management—Age 43, married, A.B. degree and B.S. in Aeronautical Engineering, plus legal training and experience. Author of seven outstanding textbooks on technical subjects. Biography in *Who's Who in America*. Member I.A.S. and Associate Member American Institute of Electrical Engineers. Last 6 years spent organizing and managing aeronautical training for engineers, pilots, and mechanics in advanced types of aircraft. Desires permanent position as organizer and manager of a well-financed college or school wishing to develop strong courses in aviation business administration, jet and gas turbine propulsion, or electronics. Prefers West Coast.

693. Development Engineer—Graduate engineer, with 8 years' experience in hydraulics, landing gear and mechanical design, seeks position with small company where the opportunity exists to expand along with the company.

692. Mechanical Engineer—Graduate; age 30; 4½ of 6 years' experience in development of mechanical components of helicopter aircraft. Interested in development work. Location: (1) New York; (2) San Francisco; (3) Seattle.

691. Aeronautical Engineer—B.Ae.E., 1942. Age 25, married. Two years' experience in design evaluation of regular and experimental aircraft. Two years' experience in aircraft flight testing and aircraft maintenance. One year's experience in supersonic research leading to the design of guided missiles. At present engaged as a research technician in supersonics. Desires administrative position as a project engineer in the research and development of supersonic aircraft. Familiar with Government contracts and procedures.

690. Administrator-Industrial Management Engineer—Representative completing 6 years in Naval Aviation as administrator of fixed price and cost-plus fixed fee airplane contracts from inception to fly-away at several large plants and the Bureau of Aeronautics. Ten years' civilian aircraft experience covering production, engineering, and quality control. Good engineering training secured at recognized technical institute and university.

689. Engineer—Five and one-half years' experience as layout draftsman on aircraft construction; location in Eastern States preferred.

688. Engineer—B.A.E., N.Y.U., major in air transport and meteorology. Two years' experience leading aircraft instrument and accessory manufacturer as designer, junior administrative engineer. Served in U.S. Navy as officer engineer in design and development of autopilots and radio-controlled aircraft and structural test models; 1 year's experience in this field including considerable flight-test work. Six months' experience with Navy as production control officer in aircraft plant. Desires work in East Coast area in any of the above fields.

687. Professor or Aeronautical Engineer—Ph.D. in Mathematics and Physics. Author of a number of published articles in aerodynamics and mathematics. Ten years' teaching experience in graduate and undergraduate engineering mathematics; over 7 years' general aircraft engineering experience, including positions as project aerodynamicist and engineering specialist on Navy and Army aircraft and guided missiles. Available for responsible position immediately either with aeronautical college or with aircraft industry

686. Sales Engineer and Aeronautical Marketing Consultant—Exceptional aeronautical background and history. Entree to every phase of aircraft manufacture and operation. Internationally known and respected. Has excellent contacts, particularly on the Pacific Coast. Has designed and patented several successful accessories. Has been in the aircraft field for over 30 years.

684. Teacher—College teacher desires position teaching aeronautical engineering at recognized college or university. Possesses B.A.E. degree, magna cum laude. Doing graduate work at present on parttime basis. Three years of progressively responsible industrial experience including analysis and design of tubular and stressed-skin structures and of the mechanical elements of civilian and military aircraft, particularly in the rotary wing field. Also some experience in theoretical aerodynamics. Over 1 year's experience as instructor of mechanical engineering at accredited college. Qualified to teach courses in aerodynamics, fluid mechanics, advanced strength of materials, airplane design, structures and stress analysis, and rotary wing aircraft.

683. Air Cargo Transport Engineer and Administrator—Available on short notice, internationally known air transportation engineer, specializing in air cargo. Just completed setting up largest all-cargo operation in Western hemisphere, in South America. Capable of making complete survey, procuring equipment and personnel, and setting up operating organization. Would be interested in acting as consultant for major railroad anticipating aircraft activity or any other organization interested in air cargo. Thirty years' experience in the aircraft operating field. Has lived and operated in Europe and South America.

682. Aeronautical or Administrative Engineer—Age 33, married. Ten years' aircraft engineering experience, including drafting of specifications, structural design, aerodynamics, and 3 years' service in the Engineering Division at Wright Field as an A.A.F. officer. Familiar with current A.A.F., Bureau of Aeronautics, British, and C.A.A. structural and design requirements. Desires position about June 1.

681. Physicist-Mathematician—Age 35. B.S. in E.E., M.A. in Mathematical Physics, B.Sc. (Oxon.) in Astrophysics. Presently Associate Professor Aerological Engineering. Four years' experience scientific book publishing (McGraw-Hill). Five and one-half years' Navy. Desires position Northeastern United States in research and/or teaching with growing responsibilities in administration.

680. Aeronautical Engineer—B.S. degree in Aeronautical Engineering, Aeronautical University, Chicago. Five years' experience in design and research with leading aircraft manufacturer, including work in stress analysis, aerodynamics, and jet propulsion. Holds private pilot's license and has had some aircraft mechanic experience. Prefers Southern California.

678. Aeronautical Engineer—With administrative experience desires position as personal assistant to executive in air line, aircraft manufacturing or related activity who should be relieved of concern over details—correspondence, reports, speeches, department liaison. Aero engineering degree, Harvard Business School. Six years' over-ocean air-line experience in maintenance and engineering, in which presently employed. Ex-Naval officer, free to travel. Has smattering of Spanish. Age 29. Interview desired.

677. Aeronautical Engineer—Technical degree received from well-known and approved cooperative engineering college of a midwestern university. Three and one-quarter years' complete stress analysis experience with leading personal plane manufacturer. Some liaison and service engineering experience. Desires position with personal plane or helicopter manufacturer or consulting engineer as a structures, service, or liaison engineer. Will consider position as aerodynamicist or sales engineer of a reliable company with a temporary salary sacrifice if well-rounded experience will be gained. Complete information will be given on request.

676. Aeronautical Engineer—B.Ae.E. More than 5 years' experience in experimental aerodynamics and flight testing. Present position is that of project engineer on high-speed developments. Desires position in Northern New Jersey or New York City which involves work in aerodynamics, design, flight testing, or wind-tunnel testing.

675. Technical Translator—Graduate mechanical and aeronautical engineer, German born, U.S.-educated, thoroughly bilingually familiar with engineering terminology, will translate German technical documents on a contract basis.

674. Aeronautical Engineer—Aerodynamicist, B.Ae.E., age 22, single. Has over 2 years' experience in wind tunnel work, air loads, performance, stability, and control. Will receive M.Ae.E. during present school year. Good background in theoretical aerodynamics, stress analysis, and jet propulsion. Interested in teaching. Must remain in New York City vicinity until July 1. Available immediately.

673. Teacher—Graduate of the Massachusetts Institute of Technology in aeronautical engineering desires a teaching or administrative position with a foreign or domestic college or university. Qualified to teach aerodynamics, airplane design, wind-tunnel techniques, modern flight-testing methods, air-transport problems, and related fundamental subjects. Holds C.A.A. single- and multiengined commercial pilot's license, with instrument and instructor ratings. Prefers position with opportunity for combining academic work with flight testing, flight demonstration, and/or flight instruction. Has had administrative, practical, and teaching experience in the aviation field. Will gladly furnish complete credentials, with references, upon request.

669. Aerodynamics Engineer—Chief aerodynamics engineer with prominent aircraft company. Advanced degree in mathematics and physics. Publications in dynamics and thermodynamics. Experience in aircraft heating and deicing. Desires position in metropolitan area with progressive concern or recognized university.

668. Administrative or Executive Engineer—Twenty years' well-rounded experience in all phases of organization, systematizing, design, engineering, production, and helicopter. Has experience in the automotive, aircraft-engine, and aircraft industries. Formerly experimental engineer, assistant engineer, factory manager, and general manager. Will definitely consider position in other than aircraft industry.

667. Aeronautical Engineer—B.S. Degree in Mechanical and Aeronautical Engineering. Taking graduate studies majoring in aeronautics.

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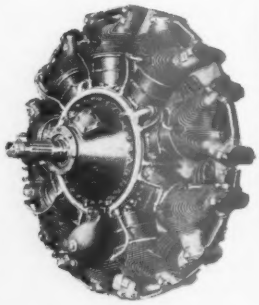

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Aircraft Engineering

FOUNDED 1929

The Technical and Scientific Aeronautical Monthly

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F.I.Ae.S., M.S.A.E., F.R.Ae.S.

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Two years' experience in drafting and aerodynamics in the aircraft industry, doing layout, major detailing, casting and forging drawing. Interested in aerodynamics or stress-analysis positions. Will accept mechanical or aeronautical engineering position in the Far East, especially in the Philippines.

666. **Sales and Service Engineer**—B.Ae.E., N.Y.U., 1941; married, age 28. Four and one-half years' A.A.F. Engineering Officer (Major). Varied technical and administrative assignments in connection with modification, overhaul, and repair of all types of aircraft and associated equipment. One year own manufacturing business. Few months air line. Completing training for Commercial Pilot Certificate. Particularly interested in sales and service or employment with overhaul and/or modification agency.

665. **Training Supervisor**—Twelve years of practical aeronautical and teaching experience, ranging from instructor to training supervisor at a U.S. Naval aircraft shore establishment. Background includes the training fields of private trade school, public school, air line, and Government plants. Capable of planning, administering, coordinating, teaching, and testing school, shop, and supervisory improvement courses. Experience has covered mechanical training on the job, apprenticeship training, supervisory improvement training and testing, and veterans' training.

664. **Aeronautical Engineer**—B.Ae.E., age 29, married, veteran of World War II. Four years as a Naval Aviator. Two thousand hours' flight experience in single- and multiengined land and sea aircraft. Possesses valid commercial pilot's license. Experience as a project engineer, design draftsman, and stress analyst. Working knowledge of all phases of aviation. Desires position as a flight test engineer. Will consider positions anywhere in the continental limits of the United States.

663. **Engineer**—Heating, ventilating, and exhaust systems engineer; B.S. in Ae.E. Age 29, married. Four and one-half years' experience in the design, maintenance, and overhaul of aircraft exhaust, heating, and ventilating systems. Completely familiar with all types of aircraft and ground heaters, heat exchangers, anti-icing and deicing systems and ventilating systems. Experienced in problems relating to aircraft-engine exhaust systems, such as collector rings, short stacks, flame dampeners, silencers, and carburetor heater shrouds. Has a working knowledge of turbosupercharger and induction systems. Exceptional executive and supervisory experience. Desires position as sales or field service engineer. Other engineering positions will be considered.

662. **Production or Factory Management**—B.S.E. (Aero. Eng.); top quarter, Big Ten University class. Six months' prewar experience in production control with leading parts manufacturer. Three years as A.A.F. engineering officer in charge of aircraft overhaul subdepot, supervising 350 civilian employees, machine shop, sheet metal, welding, woodmill, etc. One year postwar as aircraft structures engineer. Desires responsible position in production or factory management with progressive-minded manufacturer of mechanical products. Keenly interested in production control, production planning, and factory management and will consider opportunities in any related position. Mid-West preferred.

661. **Research Engineer**—Age 29. B.S. in M.E., University of Pennsylvania, 1940. Experienced analyst in thermodynamics, heat transfer, general fluid mechanics, and aerodynamics. Present employer well satisfied, but applicant wants nonmilitary research work. Six and one-half years with large aircraft manufacturer, past year and one-half on supersonic studies, including setting up Schlieren optical system and developing method of analysis for flow of compressible fluids.

660. **Engineer-Pilot**—M.E.; several years' experience many military and commercial types, land, sea, and helicopter; commercial and instrument ratings; 4 years' test and research with reputable organizations. Good knowledge of operational problems; well acquainted with current electronics equipment and its limitations. Desires change. Interested in pilot-engineering-administrative position with concern having well-backed program.

658. **Administrative-Executive-Field Service**—Desires to join group with sound research and modest production program. Twenty-one years' experience in the industry in almost every phase; now staff member in responsible position with large engine firm. Holds commercial pilot's license with instrument and instructor ratings, single- and multiengined, A and E license. Prefers to affiliate with group that can use several thousand hours' flying experience plus sales and executive ability.

656. **Management Executive**—B.S. in M.E. Over 20 years' experience in aviation, including engineering, production, quality control, materials, contracts, labor problems, costs, contract termination, and property disposal. Five years' research, N.A.C.A., hydrodynamics, and aerodynamics. One year on flight performance data analysis. A and E mechanic, private pilot. During war represented the Bureau of Aeronautics in plants of major aircraft manufacturers, heading staffs up to 160 engineering, clerical, and shop personnel. Long experience in dealing with Government agencies. Desires responsible position with an organization needing a versatile, well-informed executive.

655. **Engineer or Executive**—Twenty-four years' experience in tool, production, and design engineering; 8 years in aircraft. Positions filled include project engineer, chief tool designer, chief production engineer, and chief engineer. Thoroughly capable of handling either design, production, or tooling and methods. Willing to accept lesser position if opportunity for advancement is evident.

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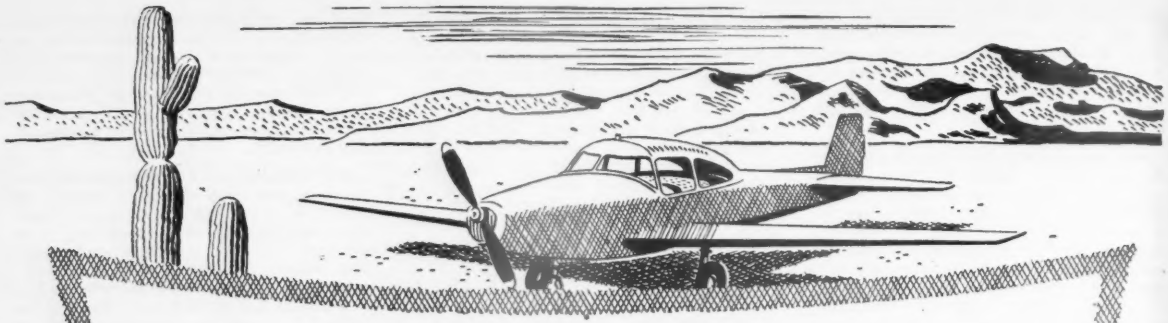

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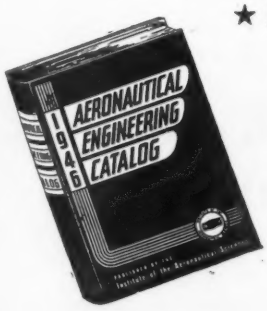

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